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PREVALENCE AND ANTIBIOGRAM PROFILE OF *PSEUDOMONAS AERUGINOSA* ON HOSPITAL EQUIPMENT AND SITES IN SELECTED HOSPITALS IN CALABAR MUNICIPALITY

S. P. Antai*, D. R. Tiku and G. E. Gladys

Department of Microbiology, University of Calabar, Calabar.

***Corresponding Author: S. P. Antai**

Department of Microbiology, University of Calabar, Calabar.

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ABSTRACT

This study was aimed at investigating the prevalence and antibiogram profile of *Pseudomonas aeruginosa* on hospital equipments and sites in selected hospitals in Calabar Municipality. Fifty (50) swab specimens were aseptically collected from intensive care units, hospital sites and equipments used in University of Calabar Teaching Hospital (UCTH), General Hospital, Calabar, and Arubah Specialist and Diagnostic Hospital Calabar. The swabs were cultured and microorganisms were identified using standard microbiological procedures. The results obtained from the study revealed a high prevalence rate of *Pseudomonas aeruginosa* in the neonatal intensive care unit (47.61%), intensive pediatric care unit (53.84%) and intensive cardiac care unit (55.55%) of General Hospital Calabar, compared to that obtained from University of Calabar Teaching Hospital and Arubah Specialist and Diagnostic Hospital Calabar. Similarly, a high prevalence rate of *Pseudomonas aeruginosa* was also recorded in the different hospital sites and equipments used in the investigated hospitals. Moreover, a higher incidence of *Pseudomonas aeruginosa* was observed in sinks (45.5%), floor (50%), nurse table (55.55%), nurse trolley (61.11%) patient bedding (69.23%), oxygen tubing (57.14%), operating table (54.17%), staff hand swab (50%) in General Hospital Calabar, compared to that obtained from collection points of the other hospitals investigated. Antibiogram studies revealed that the *Pseudomonas aeruginosa* isolates from the investigated hospital were more resistant to amoxicillin (100%), cotrimoxazole (100%), nitrofurantoin (100%), nalidixic acid (100%), ofloxacin (100%), and augmentin (100%), but least resistnce to piperacillin/trazobactum (28.5%). However, the study has revealed that the prevalence of multiple drug resistant *Pseudomonas aeruginosa* often varies dramatically between intensive care units of hospitals in the same community, in different hospital sites and equipments used in hospitals, as well as in different patient populations in hospitals. This observation was worrisome as the organism has been implicated with numerous diseases such as pneumoniae, bacteremia, meningitides, otitis media, keratitis, urinary tract infections, skin infections, among others. It is therefore important to institute a system for the surveillance, collection and collation of both clinical and microbiological data on multiple drug resistance *Pseudomonas* strains in hospital environments as this will help curb some of the threats posed by this pathogen on the quality of healthcare systems.

KEYWORDS: *Pseudomonas aeruginosa*, equipments, antibiogram.

INTRODUCTION

Pseudomonas aeruginosa is a non-fermentative aerobic, gram negative rod that normally lives in moist environments (Goldberg, 2012), and have minimal nutrition requirements while being able to use several organic compounds for growth. This metabolic versatility contributes to a broad ecological adaptability and distribution and reflects a genome of larger size and complexity compared with that of many other bacteria species (Stover *et al.*, 2013). They are infrequently found as part of the human microflora in healthy individuals, and widespread in natural environments and serves as opportunistic pathogen causing diseases in vulnerable individuals such as immuno-compromised, those whose host defences have been breached, such as burn patients and infants in whom the immune system has not yet developed (Hu *et al.*, 2012). *Pseudomonas aeruginosa* is an important nosocomial pathogen, they are gram negative motile bacillus which is invasive, toxigenic and produces pyocin (Gaynes, 2015). *Pseudomonas aeruginosa* have been known to cause broad spectrum of diseases such as urinary tract infections, burns, respiratory infections, septicemia (Morrison and Wenzel, 2010), and it is the primary cause of ventilator associated pneumonia. However, the organisms have been reported to be an important cause of healthcare- associated infections particularly among patients and infants in neonatal intensive care units (Rubin, 2008).

In recent years, nosocomial infections caused by *Pseudomonas aeruginosa* have been recognized as an acute problem in hospitals due to its intrinsic resistance to many antibiotic classes and its capacity to acquire practical resistance to all effective antibiotics (Gaynes, 2015), together with the spread of these bacteria in hospital personnel, hospital equipment, wet places, sinks, mops, disinfectant solutions, respiratory equipment, food mixers and other moist environments within hospitals (Gaynes, 2015). Unfortunately, the ability of the afore mentioned to act as reservoirs for *Pseudomonas aeruginosa* within hospital settings remain worrisome, as it reduces the quality of healthcare systems, in addition to the fact that *Pseudomonas aeruginosa* is ubiquitous in the environment thereby making the sources of its outbreak difficult to identify. Constant bacteriological monitoring of the pathogens isolated from clinical specimens from patients in special units is necessary to draw attention of clinicians and infection control specialists to their current susceptibility pattern and how often specific pathogens are isolated (Shanson, 2009). This will form the bedrock of appropriate surveillance studies in such settings that would lead to developing, implementing and monitoring the impact of interventions such as the event-based, mutually agreed guidelines for the empirical antimicrobial therapy of common pathogens, effective infection control and public health guidelines (Karlowsky *et al.*, 2002). However, it is on this basis that this research work is focused on evaluating *Pseudomonas aeruginosa* and its possible threat to the quality of healthcare systems.

MATERIAL AND METHOD

Study area
The study will be carried out within University of Calabar Teaching Hospital (UCTH) Calabar, General Hospital Calabar and Arubah Specialist and Diagnostics Hospital Calabar.

Sample collection
Multiple environmental swab samples using swab sticks were collected under aseptic conditions from various sites of Intensive Care Units (ICU), wards (patients table, trolley, skin, wall, floor, oxygen and suctton tubings, A/C filters), hospital instruments (stethoscopes and ventilators) and hospital staff (hand swabs) of University of Calabar Teaching Hospital (UCTH), Calabar, General Hospital Calabar and Arubah Specialist and Diagnostics Hospital Calabar. After which the swab samples were then transported to the laboratory of Department of Microbiology, University of Calabar for further processing. Standard microbiological procedures for handling and transporting of specimens as enunciated by Cheesbrough (2002) were followed.

Materials
Laboratory equipments
Laboratory equipments used for this study include; autoclave, microscope, perti-dishes, conical flask, test-tubes, foil-paper, incubator, glass slides, wire loop, bursen-burner, test-tube rack, masking tape etc.

Media
The media used for this study were, *Pseudomonas aeruginosa* isolation agar and Mueller Hinton agar (oxoid, England) and were prepared in accordance with the manufacturer's instructions.

Method
Samples processing
All the swabs collected for bacteriological investigations were analyzed in accordance to the method of Isenberg *et al.*, (2011). *Pseudomonas* Isolation Agar (PIA) was prepared following the manufacturer's instructions and allowed to solidify. The samples were inoculated into agar plates and incubated at 37^0C for 24hours.

Characterization and identification of isolates
Characterization and identification of the isolates were carried out in line with standard operating procedures (Cheesbrough, 2002). The presence of blue to blue-green pigmented colonies was confirmed as *Pseudomonas aeruginosa*.

Antibiotic sensitivity testing
Antibiotic susceptibility tests was carried out by disk diffusion technique according to CLSI guideline (Brooks *et al.*, 1991). Mueller Hinton Agar was used for growing the lawn of culture of *Pseudomonas aeruginosa* by swabbing the culture onto the agar plate. Different antibiotic discs were then placed equidistant and the plate, were incubated at 37^0C for 24 hours (Bauer *et al.*, 1966). The following antibiotics discs was used, amoxicillin (25µg), augmentin (30µg), chloramphenicol **(**30µg), gentamycin (10µg), ciprofloxacin (10µg), piperacillin/trazobactum (100µg), cefriazone (30µg), ofloxacin (30µg), nitrofurantoin (30µg), nalidixic acid (30µg) and cotrimoxazole (25µg).

RESULTS

Frequency occurrence and percentage prevalence of *Pseudomonas aeruginosa* in different intensive care units of the selected hospitals
Table 1 present the result of frequency of occurrence of *Pseudomonas aeruginosa* in different intensive care units of the selected hospitals. It showed that General Hospital Calabar had the highest *Pseudomonas aeruginosa* occurrence in the neonatal intensive care unit (10), intensive pediatric care unit (7) and intensive cardiac care unit (5) compared to that of University of Calabar Teaching Hospital (neonatal intensive care unit (9), intensive pediatric care unit (5) intensive cardiac care unit (3)) and Arubah Specialist and Diagnostic Hospital (neonatal intensive care unit (2), intensive paediatric care unit (1) and intensive cardiac care unit (1)).

Table 2 present the result of percentage prevalence of *Pseudomonas aeruginosa* in the different intensive care units of the selected hospitals. It showed that General

Hospital Calabar had the highest percentage prevalence of *Pseudomonas aeruginosa* in all the intensive care units studied (neonatal intensive care unit (47.61%) intensive pediatric care unit (53.84%) and intensive cardiac care unit (55.55%) as compared to that of University of Calabar Teaching Hospital (neonatal intensive care unit (42.85%), intensive pediatric care unit (38.48%) and intensive cardiac care units (33.33%)) and Arubah Specialist and Diagnostic Hospital Calabar (neonatal intensive care unit (9.5%) intensive paediatric care unit (7.69%) and intensive cardiac care unit (11.11%)) (fig 1).

Frequency of occurrence and percentage prevalence of *Pseudomonas aeruginosa* in different hospital sites and equipments used in the selected hospitals

Table 3 present the result of the frequency of occurrence of *Pseudomonas aeruginosa* in the different hospital sites and equipments used in the selected hospitals. It showed that General Hospital, Calabar had the highest incidence of *Pseudomonas aeruginosa* in sinks (15), floor (13) nurse table (10), nurse trolley (11), patient bedding (9), oxygen tubing (4), operating table (13), patient trolley (12), suction apparatus (14) and staff hand swab (6), compared to University of Calabar Teaching Hospital (with sinks (13), floor (10), nurse table (7), nurse trolley (5) patient bedding (3), oxygen tubing (2), operating table (9), patient trolley (10), suction apparatus (12) and staff hand swab (4)) and Arubah Specialist and Diagnostic Hospital, Calabar (sinks (5), floor (3), nurse table (1), nurse trolley (2), patient bedding (1), oxygen tubing (1), operating table (2), patient trolley (2), suction apparatus (4) and staff hand swab (2).

Figure 2 to 4 present the results of percentage prevalence of *Pseudomonas aeruginosa* in different hospital sites and equipments used in the selected hospitals. It showed that General hospital, Calabar had the highest percentage prevalence of *Pseudomonas aeruginosa* in all the hospital sites and equipments investigated [(sinks (45.5%), floor (50%), nurse table (55.55%), nurse trolley (61.11%), patient bedding (69.23%), oxygen tubing (57.14%), operating table (45.17%), patient trolley (50%)] suction apparatus (46.67%), staff hand swab(50%) (Fig. 2), as compared to University of Calabar Teaching Hospital [(sinks (39.40%), floor (38.46%), nurse table (38.89%), nurse trolley (27.80%), patient bedding (23.08%), oxygen tubing (28.57%), operating table (37.50%), patient trolley (41.67%), suction apparatus (40%) and staff hand swab (33.33%)] (Fig 3) and Arubah Specialist and Diagnostic Hospital, Calabar [(sinks (15.15%), floor (11.54%), nurse table (5.56%), nurse trolley (11.11%), patient bedding (7.69%), nurse trolley (14.30%), operating table (8.33%), patient trolley (8.33%) suction apparatus (13.33%) and staff hand swab (16.67%)] (Fig. 4)

Antibiotic susceptibility profile of *Pseudomonas aeruginosa* isolates from hospital sites and instruments of the selected hospitals

Table 4 present the result of antibiotic susceptibility profile of *Pseudomonas aeruginosa* isolate from hospital sites and equipments used in the selected hospitals. It showed that all the *Pseudomonas aeruginosa* isolates were resistant to amoxillcin (100%), cotrimoxazole (100%), nitrofuratoin (100%), nalidixic acid (100%) and ofloxacin (100%), while they showed in the least resistance to piperacillin/trazobactum (28.57%), followed by ciprofloxacin (57.14%) then gentamycin (71.42%) and chloramphenicol (71.42%).

Distribution and proportion of antibiotic resistance among *Pseudomonas aeruginosa* isolates in hospital sites and equipments used in the selected hospitals

Table 6 present the result of the distribution and proportion of antibiotic resistance among *Pseudomonas aeruginosa* isolates from the hospital sites and instruments used in the selected hospitals. It showed that all the isolates (A_1-A_7) were resistant to amoxicillin (100%), while all the isolates were sensitive to piperacillin/trazobactum (0% resistance) except for isolate A_4 and A_7 that showed 20% resistance. The result also revealed that among the *Pseudomonas aeruginosa* isolates from the hospital sites and instruments investigated, A_4 showed the highest multiple antibiotic resistance to the antibiotics tested against (amoxicillin (100%), cotrimoxazole (100%), nitrofurantoin (100%), nalidixic acid (100%), ofloxacin (100%), augmentin (100%), ceftriazone (100%) and chloramphenicol (100%).

Table 1: Frequency of occurrence of *Pseudomonas aeruginosa* in different intensive care units in the selected hospitals.

Hospitals	Intensive care unit (ICU)	Frequency of occurrence
University of Calabar Teaching Hospital (UCTH)	Neonatal intensive care unit (NICU)	9
	Intensive pediatric care unit (IPCU)	5
	Intensive cardiac care unit (ICCU)	3
General Hospital Calabar	Neonatal intensive care units (NICU)	10
	Intensive pediatric care unit (IPCU)	7
	Intensive cardiac care unit (ICCU)	5
Arubah Specialist and Diagnostics Hospital Calabar	Neonatal intensive care units (NICU)	2
	Intensive pediatric care unit (IPCU)	1
	Intensive cardiac care unit (ICCU)	1

Table 2: Percentage prevalence of *Pseudomonas aeruginosa* in different intensive care units in selected hospitals.

Intensive care units	Hospital	% prevalence
Neonatal intensive care unit (NICU)	University of Calabar Teaching Hospital (UCTH)	42.8
	General Hospital Calabar	47.61
	Arubah Specialist and Diagnostic	9.52
Intensive pediatric care unit (IPCU)	University of Calabar Teaching Hospital (UCTH)	38.46
	General Hospital, Calabar	53.84
	Arubah Specialist and Diagnostic Hospital Calabar	7.69
Intensive cardiac care unit (ICCU)	University of Calabar Teaching Hospital (UCTH)	33.33
	General Hospital Calabar	55.55
	Arubah Specialist and Diagnostic Hospital Calabar	11.11

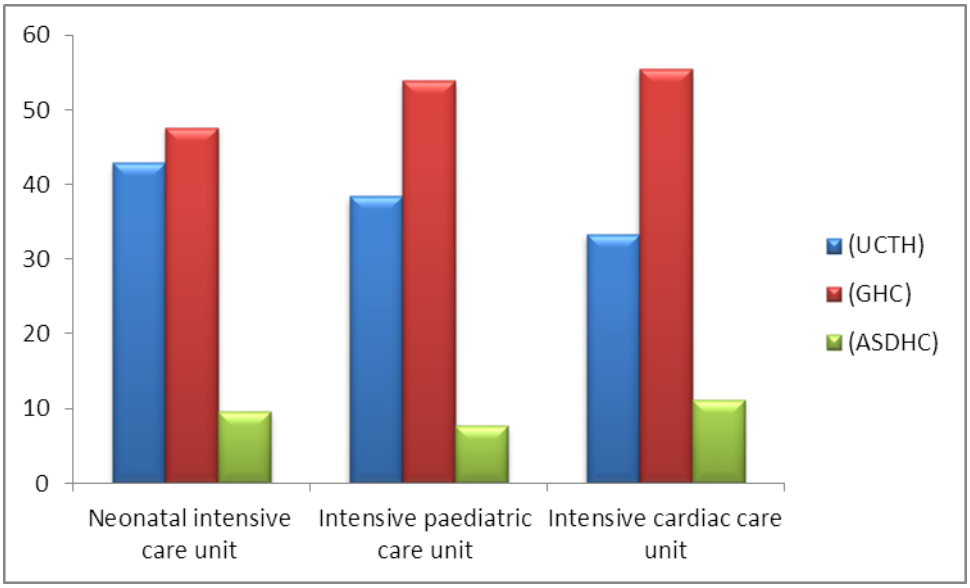

Fig. 1: prevalence of *Pseudomonas aeruginosa* in the different intensive unit of the selected hospitals.

Table 3: Frequency of occurrence of *Pseudomonas aeruginosa* in different hospital sites and instruments in the selected hospitals.

Hospital	Hospital sites and instruments	Frequency of occurrence
University of Calabar Teaching hospital (UCTH)	Sinks	13
	Floor	10
	Nurse table	7
	Nurse trolley	5
	Patient bedding	3
	Stethos cope	0
	Oxygen tubing	2
	Operating table	9
	Patient trolley	10
	Suction apparatus	12
	Staff hand swab	4
General hospital Calabar	Sinks	15
	Floor	13
	Nurse table	10
	Nurse trolley	11
	Patient bedding	9
	Stethos cope	0
	Oxygen tubing	4
	Operation	13
	Patient trolley	12
	Suction apparatus	14
	Staff hand swab	6

Arubah Specialist and Diagnostic Hospital Calabar	Sinks	5
	Floor	3
	Nurse table	1
	Nurse trolley	2
	Patient bedding	1
	Stethos cope	0
	Oxygen tubing	1
	Operation	2
	Patient trolley	2
	Suction apparatus	4
	Staff hand swab	2

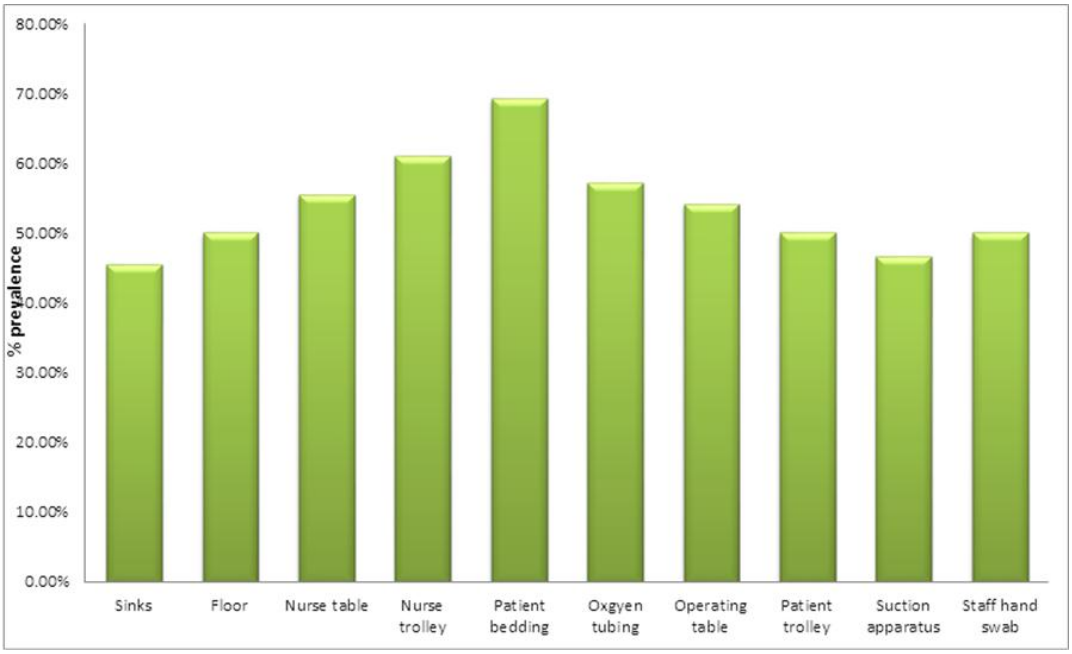

Fig. 2: Percentage prevalence of *Pseudomonas aeruginosa* in different hospital sites and equipments used in General Hospital Calabar.

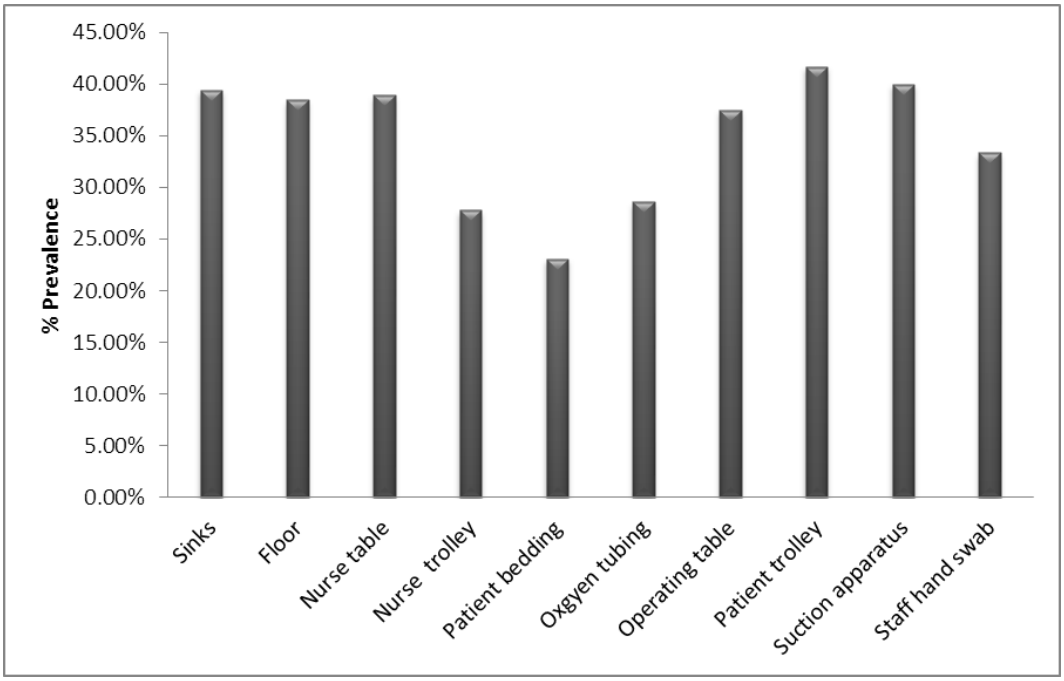

Fig. 3: Percentage prevalence of *Pseudomonas aeruginosa* in different hospital sites and equipments used in University of Calabar Teaching Hospital (UCTH), Calabar.

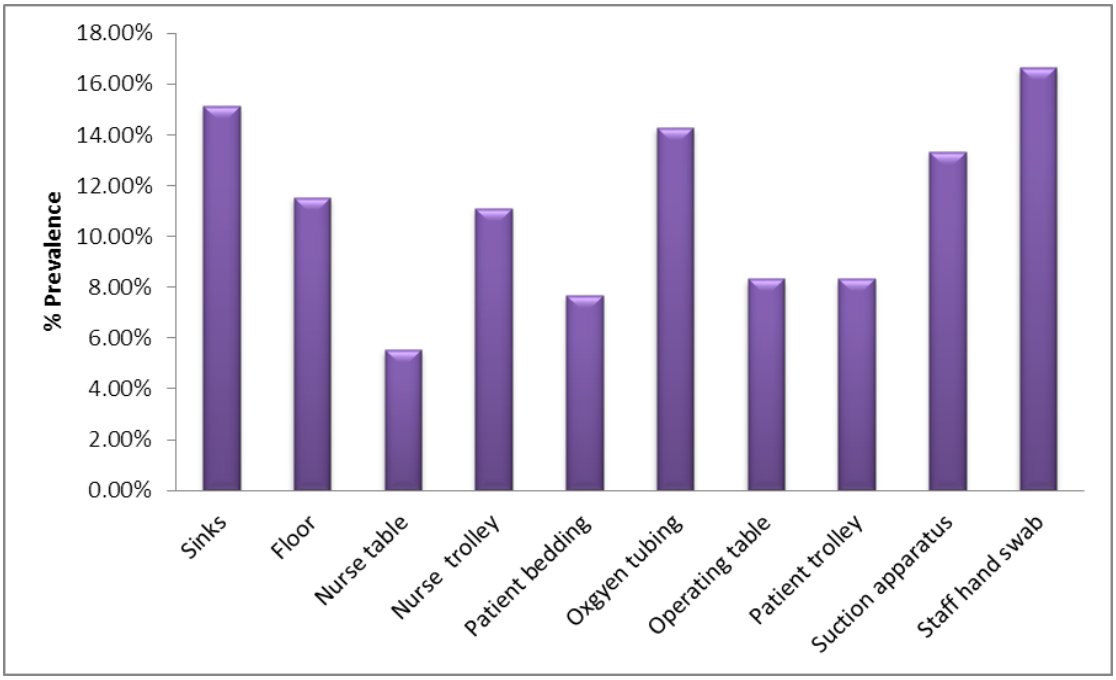

Fig. 4: Percentage prevalence of *Pseudomonas aeruginosa* in different hospital sites and equipments used in Arubah Specialist and Diagnostic Hospital, Calabar.

Table 5: Antibiotic susceptibility profile of *Pseudomonas aeruginosa* isolates from hospital sites and equipments used in the selected hospitals.

Antibiotics	**Disc potency (mg/ml)**	**Isolate code**							
		A_1	**A_2**	**A_3**	**A_4**	**A_5**	**A_6**	**A_7**	**% of all isolate s**
Amoxicillin	25	R	R	R	R	R	R	R	100
Cotrimoxazole	25	R	R	R	R	R	R	R	100
Nitrofurantoin	30	R	R	R	R	R	R	R	100
Gentamycin	10	R	S	S	R	R	R	R	71.42
Nalidixic acid	30	R	R	R	R	R	R	R	100
Ofloxacin	30	R	R	R	R	R	R	R	100
Augmentin	30	R	R	R	R	R	R	R	100
Ciprofloxacin	10	R	R	R	R	R	R	S	57.14
Ceftriazone	30	S	S	R	R	R	R	S	85.71
Chlorampenicol	30	R	R	R	R	R	S	S	71.42
Piperacillin/Trazobactum	100	S	S	S	R	S	S	R	28.57
% resistance of single organisms		81.81	72.72	81.81	100	90.91	81.81	72.73	

Table 6: Distribution and proportion of antibiotic resistance among *Pseudomonas aeruginosa* isolates in hospital sites and equipments used in the selected hospitals.

Isolate code	No	Total number and percentage resistance to each antibiotics										
		AMX(%)	COT (%)	NIT (%)	GEN (%)	NAL (%)	OFL (%)	AUG (%)	CIP (%)	CEF (%)	CHL (%)	PT (%)
A_1	5	5(100)	5(100)	5(100)	5(100)	4(80)	4(80)	4(80)	1(20)	4(80)	5(100)	0(0)
A_2	5	5(100)	5(100)	5(100)	2(40)	5(100)	5(100)	5(100)	1(20)	5(100)	4(80)	0(0)
A_3	5	5(100)	4(80)	4(80)	3(60)	4(80)	5(100)	5(100)	2(40)	5(100)	5(100)	0(0)
A_4	5	5(100)	5(100)	5(100)	4(80)	5(100)	5(100)	5(100)	3(60)	5(100)	5(100)	1(20)
A_5	5	5(100)	4(80)	4(80)	5(100)	4(80)	5(100)	4(80)	2(40)	5(100)	5(100)	0(0)
A_6	5	5(100)	5(100)	5(100)	4(80)	5(100)	5(100)	5(100)	4(80)	5(100)	3(60)	0(0)
A_7	5	5(100)	4(80)	5(100)	4(80)	5(100)	5(100)	5(100)	1(20)	4(80)	1(20)	1(20)
	35	35(100)	32(91.43)	33(94.23)	27(77.14)	32(91.43)	34(97.14)	33(94.23)	14(40)	33(94.23)	28(84.85)	2(57.14

Legend: Amx = Amoxicillin, COT = Cotrimoxazole, NIT= Nitrofurantoin, GEN= Gentanycin, NAL = Nalidixic acid, OFL = Ofloxacin, AUG = Augmentin, CIP = Ciprofloxacin, CEF = Ceftriazone, CHL = Chloramphenicol, PT = Piperacillin/Trazobactum

DISCUSSION

Microorganisms are commonly attached to hospital environments and in dwelling medical devices (such as urinary catheters, trolley, tubing and suction apparatus, among others) to form bioflims made up of extracellular polymers (Dulworth & Pyenson, 2012). The high frequency and percentage occurrence of *Pseudomonas aeruginosa* observed in the different intensive care units, hospital sites and equipments from the selected hospitals investigated was not surprising, as this observation corroborates with reports from similar researches. Hossen *et al.,* (2012) reported to have isolated *Pseudomonas aeruginosa* from hospital means and hospital personnel in selected hospital in Iran, Jeffenes *et al.,* (2012) also reported to have identified *Pseudomonas aeruginosa* outbreaks in the neonatal intensive care unit in University Hospital Southampton. Similar study by Olayinka *et al.,* (2015) reported a high prevalence rate of *Pseudomonas aeruginosa* in federal medical centre Makurdi, General Hospital and Gboko, General Hospital Otukpo and General Hospital North bank, Makurdi.

Pseudomonas aeruginosa is a ubiquitous microorganism, and could affect individual with immunocompromised situation and are responsible for nosocomial infection (Yang *et al.,* 2011). It has not only metabolic versatility and remarkable ability to adaptation and colonization in wide variety of ecologic environments but also notability for its intrinsic ability to resistance to wide variety of antimicrobial agents as well as its mucoid form of adaptation mechanism in surviving in environments that are concerned to polysaccharide net as called alginate (Nseir *et al.,* 2011). The high prevalence *Pseudomonas aeruginosa* in the intensive care units of two of the three selected hospitals studied was not surprising, as this observation was in line with that of Jarlier *et al.,* (2014) who reported a higher incidence of *Pseudomonas aeruginosa* (52.35%) in ICU studied. Also Naze *et al.,* (2010) in their studies, reported nosocomial outbreaks of *Pseudomonas aeruginosa* colonization or infection of infant in neonatal intensive care units from 17 different hospitals. Intensive care patients are more prone to infection because of the debilitating effect of a prolonged hospitalization and instrumentation. Intensive care units are generally considered epicenter of multi drug resistant (MDR) organisms, with the most important risk factors been excessive use of antibiotics exerting selective pressure on bacteria, the frequent use of invasive devices and relative density of immuno-suppressed patient population with severe underlying diseases (Ramprasael *et al.,* 2010). In support of the aforementioned observations in this study, various studies reviewed have provided evidence that *Pseudomonas aeruginosa* can be introduced into hospital intensive care units via a number of routes , including environmental contamination, transmission by healthcare workers, transfer of colonized patterns and through the use of contaminated water to prepare milk or other nutrition (Hu *et al.,* 2010).

Water as an environmental source of infection was a common factor in among studies which identified point source outbreaks of *Pseudomonas aeruginosa* infections. In this study a high prevalence of *Pseudomonas aeruginosa* was observed in various sites and instruments (floor, nurse and patient trolley, patient bedding) used in the selected hospitals. In support of this observation, Gras-le Guen *et al.,* (2013) reported hospital water baths and pasteurizer used to sterilize milk to be possible reservoirs of *Pseudomonas aeruginosa*. Also Moolengar *et al.,* (2010) reported to have identified *Pseudomonas aeruginosa* as an outbreak brain in a hospital sink drain. Zabel *et al.,* (2004) reported that hospital humidifying of equipment for ventilators are possible reservoirs of *Pseudomonas aeruginosa*. In support of this, various researches have reported *Pseudomonas aeruginosa* to be primarily an environmental organisms that is adapted to survive in numerous conditions and is particularly well adapted to wet or damp conditions. Nevertheless, environmental reservoirs such as sinks have the potential to lead to outbreaks. An outbreak due to splash back from contaminated sink drains was reported from the ICU and transplant unit of a Canadian hospital in 2009 (Hota *et al.,* 2009). The high prevalence rate of *Pseudomonas aeruginosa* observed in the ICU, different sites and instruments in the investigated hospitals was worrisome, as the pathogen has been implicated with numerous disease condition ranging from pneumoniae, bacteremia, urinary tract infections, meningitidis, among others (Hota *et al.,* 2009). Nowadays, prevalence of multidrug resistant strains of *Pseudomonas aeruginosa* are observed mainly in hospital acquired infections due to selective pressure exerted on bacteria by over- usage of broad spectrum antibiotics (Jones, 2011). In this study, *Pseudomonas aeruginosa* isolates (A_1 to A_7) from hospital sites and instruments in the selected hospitals investigated, showed multiple antibiotic resistant to the antibiotics tested against. A higher percentage resistance (100%) was observed with amoxicillin, cotrimoxazole, nitrofurantoin, nalidixic acid, ofloxacin and augmentin, while a percentage resistance of 85.71%, 71.42%, and 57.14% was observed with ceftiazone, gentamycin, chloramphenicol, and ciprofloxacin respectively. The least resistance (28.57%) was observed with piperacillin/Tazobactum. This observation corroborates with that of Inan *et al.,* (2000), who reported to have isolated 60-80% multiple drug resistant *Pseudomonas aeruginosa* strains from ICU patients in Turkey. He further reported that the strains showed varying percentage resistances to gentamycin (67%), imipenem (26%), ceftriazone (77%). In another survey in Spain, Bouza *et al.,* (2013) reported that isolates from their intensive care units were resistant to treonam, cefepime, ceftriazone, nalidixic acid, and amoxicillin than those from other clinical settings. The high incidence of this multiple drug resistant *Pseudomonas aeruginosa* in the investigated hospital sites and instruments could be related to indiscriminate use of antibiotics without laboratory diagnosis and antibiotic sensitivity reports (Hugbo & Olurinola, 2008). This single factor could

eliminate the normal flora and provide a non competitive environment for *Pseudomonas aeruginosa*. However, the resistance of *Pseudomonas aeruginosa* to the antimicrobial agents, together with their nutritional versalit, and the difficulties encountered in maintaining proper hygiene standards especially among personnel involved in general care of both the hospital environments and patients may have contributed to the high rate of *Pseudomonas aeruginosa* in the hospital sites and equipments of the investigated hospitals.

CONCLUSION

The study has revealed the prevalence of multiple drug resistance *Pseudomonas aeruginosa* in hospital intensive care units, as well as in different hospital sites and instruments. It is therefore important to institute a system for the surveillance, collection and collation of both clinical and microbiological data on multiple drug resistance *Pseudomonas aeruginosa* strains in hospital environments, as this will help curb some of the treat posed by this pathogen on the quality of health care system.

RECOMMENDATIONS

1. The prevalence of antimicrobial pathogens often varies dramatically between communities, hospitals in the same community and among different pattern populations in the same hospitals. Faced with this variations, the physician in clinical practice has the responsibility of making clinical judgement about likely pathogens involved in the infection process. To effectively and correctly make such judgements, hospitals should have up-to-date data on the prevalence and antimicrobial resistance pattern of commonly encountered pathogens in their practice setting.
2. Improved hand hygiene measures at the point of hospital care, re-enforcement of infection control guidelines and education of healthcare staff could as well be a part of successful *Pseudomonas aeruginosa* infection control interventions in hospital settings.

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