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Full Length Research Paper

Antibiotics sensitivity pattern of *staphylococcus aureus* from fomites in the Obafemi Awolowo University Teaching Hospital Complex (OAUTHC) Nigeria

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This study determines the possible roles of cross contamination in the hospital environment. Two hundred swabs were obtained from doctors' stethoscope diaphragm, cell phones of Health Care Workers (HCWS), patients' bed linen, pillows and door knobs at the Obafemi Awolowo University Teaching Hospitals Complex, Ile- Ife, from September 2003 to September 2005 using sterile cotton-tipped applicators. Cultures from the swabs were screened for *Staphylococcus aureus*. The results show that 18.70% of the doctors' stethoscopes, 20.33% of the doctors' cell phones, 20.33% of the door knobs were contaminated with *S. aureus.* Less than 99% of the isolated strains of *S. aureus* were sensitive to vancomycin, and rifampin, 95.12% to chloramphenicol, while 88% were sensitive to lincomycin, ciprofloxacin, and cotrimoxazole, 73% to gentamicin, cephalothin and cephalexin, while 70% were sensitive to amikacin and erythromycin. The isolates were sensitive to all tested antibiotics to different degrees except penicillin. The risk of having population of *S. aureus* strains with high multi-drug resistance is high in the study area, There is need to address indiscriminate use of antibiotics and other risk behaviors related to hygiene measure of the Health Care Workers.

Key words: Fomites, Health Care Workers (HCWs), *Staphylococcus aureus*.

INTRODUCTION

Despite remarkable advances in Medical research and treatment during the 20th century, infectious diseases remain among the leading cause of death worldwide (NIAID, 2010). Of these, nosocomial infections comprise about 5 to 10% (Culver et al., 1985).

It has been estimated that one third of all nosocomial infections may be preventable and are frequently caused by organisms acquired within the hospital environment (Hughes, 1988). In the United Kingdom, two national prevalence studies have shown that approximately 10% of patients in hospitals are admitted with infection and a further 10% acquire infection while receiving care (Plowman et al., 2000). Recommendations for infection control practices in hospitals are well documented and updated on a regular basis (Garne, 1996).

Staphylococcus aureus is consisted as normal flora (Tolan, 2007). Some studies have evaluated *S. aureus* in contamination of various items such as stethoscopes (Cohen and Matalon, 1997) contamination of computer devices (Devine et al., 2001) and in cell phones and television sets (Stacey et al., 1998). Door handles of hospital rooms that are frequently entered by staff may be a secondary reservoir. Contamination of handles of hospital door rooms may occur by inadequate compliance with hand hygiene regulation by staff such as cleaners and patient's family members (Oie et al., 2002).

The new guidelines published by the Infection Control Nurses Association (ICNA) in 2002 emphasized the primary role of hand decontamination in the prevention of transmission of infection.

The transmission of organism from artificially contaminated "Donor" fabrics to clean "recipient" fabrics via hand contact has also been reported (Marple and Tower, 1979). The results indicated that the number of organisms was greater if the donor fabric or the hands were wet upon contact (Marple and Towers, 1979). Overall, only 0.06% of the organisms obtained from the

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contaminated donor fabrics were transferred to recipient fabric via hand contact. Organisms are transferred to various types of surfaces in much larger numbers (i.e. $<10^4$) from wet hands than from hands that are thoroughly dried (Patrick et al., 1997).

Abraham and Jacob, (2005) found that a significant percentage of cell phones were contaminated with multi – drug resistant *Acinetobacter* sp*.* And that cross contamination between hands, cellphones and patients occurred in which 10% cases were implicated for contamination of hands and cellphones.

This study was designed to determine the extent of contamination of common medical equipment with micro-organisms commonly associated with infection in the hospital environment. We isolate and characterize the microorganisms involve, and hence detect the relative importance of the sources of *S. aureus* in cross infection between patients and health care personnel via fomites in the hospital wards and determine the antibiotics sensitivity pattern of the *S. aureus* isolated.

MATERIALS AND METHODS

Hospital setting

Obafemi Awolowo University Teaching Hospital Complex (OAUTHC), Nigeria was established in 1995 in Ile –Ife, Osun State. Ile Ife is an ancient Yoruba ethnic city in the South West region and one of the largest ethno-linguistic groupings in Africa. The city is regarded as origin of Yoruba cultures, industry and of Yoruba descent with acronym “Athens of Africa.” Evidence of urbanization in the ancient community has been discovered to date back to roughly 500AD. It is located in the present day Osun State with population of 501,952.

The hospital serves the University community and the ancient environs.

Sample collection

Using sterile cotton tipped applicators (Sterilin England) a total of two hundred swabs from different kinds of fomites and from various wards in the Obafemi Awolowo University Teaching Hospital Complex (OAUTHC), Ile-Ife, was obtained between September 2003 and September 2005. Fifty samples were taken from each of the Male and Female Medical wards and also Male and Female Surgical wards consisting of ten per fomite under study.

Isolation and characterization

The swabs were inserted aseptically into test-tubes containing freshly prepared nutrient broth and incubated at 37°C for 36 to 48 h. Identification of *S. aureus* isolates was based on growth and fermentation on mannitol salt agar, and its colonial morphology on nutrient agar. Other tests performed included Gram stain (Gram positive cocci in clusters) and positive results for catalase, tube coagulase and DNase tests for the determination of deoxyribonuclease activity as described by (MacFaddin, 1985).

Antibiotic susceptibility test

The pattern of antibiotic sensitivity of *S. aureus* to 12 antibiotics (penicillin, cephalothin, cephalexin, gentamicin, amikacin, co-trimoxazole, erythromycin, lincomycin, rifampin, chloramphenicol, ciprofloxacin and vancomycin) was determined using the disk diffusion method according to the National Committee for Clinical Laboratory Standards (now Clinical Laboratory Standards Institute) guidelines (NCCLS, 2003). All tests were performed on Mueller-Hinton agar (Oxoid) supplemented with 4% NaCl and Oxacillin (6 µg/ml).

RESULTS AND DISCUSSION

Growth on mannitol salt agar indicated salt tolerance, fermentation of the salt agar medium indicated by colour change from red to yellow confirmed Staphylococci, the positive tube coagulase and the inoculation of the DNase agar with successive isolates and flooded the plates with 1 N hydrogen chloride (HCL) allowing penetration of the acid for 2 min with effective clear zones around the colonies characterized *S. aureus*.

The results obtained from different wards in OAUTHC showing the occurrence of *S. aureus* contamination of common equipment and hospital fomites are presented in Table 1. From the Male Medical Ward (MMW) the percentage occurrence of *S. aureus* varied from 17.85 to 25.00%. Door knobs had the highest *S. aureus* contamination of 25.00% followed by the patients’ pillows 21.43%.

From the medical personal equipment examined in the Female Medical Ward (FMW), the percentage occurrence of *S. aureus* varied from 16.13 to … 25.81%. Cell phones had the highest occurrence of *S. aureus* of 25.81% followed by stethoscopes, pillow and bed linen with an occurrence of 19.5%.

From the medical personal equipment examined at the Male Surgical Ward (MSW), the percentage occurrence of *S. aureus* varied from 10.34 to 27.59%. Bed linens had the highest number of *S. aureus* at 27.59% followed by pillows 24.14% and door knobs 20.69%.

For the Female Surgical Ward (FSW), the percentage occurrence of *S. aureus* varied from 17.14 to 25.71%. Cell phones had the highest number of *S. aureus* contaminants of 25.71% followed by 20.00% for stethoscopes and pillows, while bed linens, and door knobs each gave 17.14%.

Table 2 shows the percentage summation for occurrence of *S. aureus* isolates per medical/personal equipment examined in all the four wards (MMW, FMW, MSW and FSW).

In this study, 18.7% isolates of *S. aureus* were obtained from the stethoscope examined in all the wards. This is lower than 54.5% occurrence reported by several other authors (Herman et al., 1997).

In their study, 55 stethoscopes belonging to pediatric physicians working in 12 community clinics were sample for bacteria cultures thereby establishing that fomites can habour potentially pathogenic bacteria. This is also in agreement with the findings of Gerken et al. (1972) and Smith et al. (1996) which inferred that the stethoscopes,

Table 1. The bacterial isolates obtained from different hospital wards.

Hospital wards	Medical/Personal equipment examined	Number of all Staphylococcal isolates recovered	% Occurrence of isolates per ward	Number of *S. aureus* obtained	% Occurrence of *S. aureus*
Male medical	Stethoscopes (10)	6	16.67	5	17.85
	Cell phones (10)	8	22.22	5	17.85
	Door knobs (10)	9	25.00	7	25.00
	Pillow (10) (10)	7	19.44	6	21.43
	Bed linen (10)	6	16.67	5	17.85
Total	50	36		28	
Female medical	Stethoscopes (10)	7	16.28	6	19.35
	Cell phones (10)	10	23.26	8	25.81
	Door knobs (10)	10	23.26	6	19.35
	Pillow (10) (10)	7	16.28	5	16.13
	Bed linen (10)	9	20.93	6	19.25
Total	50	43		31	
Male surgical	Stethoscopes (10)	5	12.50	5	17.24
	Cell phones (10)	6	15.00	3	10.34
	Door knobs (10)	10	25.00	6	20.69
	Pillow (10) (10)	9	22.50	7	24.14
	Bed linen (10)	10	25.00	8	27.59
Total	50	40		29	
Female surgical	Stethoscopes (10)	9	20.00	7	20.00
	Cell phones (10)	9	20.00	9	25.71
	Door knobs (10)	9	20.00	6	17.14
	Pillow (10) (10)	10	22.20	7	20.00
	Bed linen (10)	8	17.78	6	17.14
Total	50	45		35	

Table 2. Percentage occurrence of *S. aureus.*

Medical/Personal equipment examined	Total *S. aureus* isolates obtained in all the wards N = 123	Total *S. aureus* isolates (%)
Stethoscope	23	(18.70)
Cell phones	25	(20.33)
Door knobs	25	(20.33)
Pillow	25	(20.33)
Bed linen	25	(20.33

which constitute the universal tool of medical profession, may be a vehicle for nosocomial infections. Indeed several studies in hospital settings demonstrated that stethoscopes are frequently contaminated with staphylococcal species and could serve as agents of infections.

The findings in this study show that cellphones contributed 20.33% of all the contaminants. This is in support of the study conducted by Borer and Gillard (2005) in a tertiary care hospital in Israel where MDR *Acinetobacter* spp. is endemic. Cell phones were thought to be particularly problematic in carrying infectious agents. Further in support are the reports by Singh (1998) and Porath (2005) which showed that cellphones of medical personnel, when compared with other stationery devices have a notable role in the nosocomial

Table 3. Antibiotic sensitivity patterns among clinical isolates of *S. aureus* obtained from the hospital fomites.

Antibiotics	Total (n=123)	Sn_1	%	Rn_2	%
Vancomycin	123	121	98.37	2	1.63
Rifampin	123	121	98.37	2	1.63
Chloramphenicol	123	117	95.12	6	4.88
Lincomycin	123	109	88.62	14	11.38
Ciprofloxacin	123	109	88.62	14	11.38
Cotrimoxazole	123	107	86.99	16	13.01
Gentamicin	123	91	73.98	32	26.02
Cephalotin	123	91	73.98	32	26.02
Cephalexin	123	90	73.17	33	26.83
Amikacin	123	87	70.73	36	29.27
Erythromycin	123	87	70.73	36	29.27
Penicillin	123	2	1.63	121	98.37

Sn_1: Number of sensitive isolates; Rn_2 : Number of resistant isolates.

transmission of pathogenic microbes to patients, it could facilitate intra-and interwards (and perhaps inter-hospitals) transmission.

It is interesting to note that 20.33% of the total number of isolated *S. aureus* was from all the door knobs in the wards and this is in agreement with the work of Tallon (1999) which revealed that door handles of hospital rooms frequently used by staff, may be a secondary reservoir of S. aureus. It was also reported by Oie et al. (2002) that door handles in 27.0% of 196 rooms were contaminated by methicillin resistant *S. aureus* (MRSA). In their finding, MSSA detected on door handles constituted of 20.9%, MRSA on door handles constituted of (8.7%) while MSSA and MRSA on the same door handles was 2.6%. The *S. aureus* contamination rate on door handles of patients' rooms with *S. aureus* was 7.4%. Pillows and bed linens in all the wards studied contributed 25 (20.33%) occurrence, which shows the possibility of transmission of organisms from contaminated fabrics to clean fabrics via hands. This was corroborated by the report of Marple and Tower, (1979) and the Department of Health Safety in Laundering Guidelines (1988) that the number of organisms transmitted was greater if the donor fabric or the hands were wet upon contact. *S. saprophyticus, S. aureus, Pseudomonas aeruginosa* and *Serrattia* spp. were also transferred in greater numbers than *Escherichia coli* from contaminated fabric to clean fabric after hand contact (Markintosh and Hoffman, 1984). Organisms are transferred to various types of surfaces in much larger numbers (that is, > 104) from wet hands than from hands that are thoroughly dried (Patrick et al., 1997).

The antibiotic sensitivity pattern of the 123 clinical isolates of *S. aureus* obtained from the hospital formites is shown in Table 3.

From this, only 2 strains of *S. aureus* isolated, which constitutes 1.63% was resistant to vancomycin and rifampin while 99.19% were sensitive to these antibiotics. Furthermore, 95.12, 88.62, 88.62, 86.99, 73.98, 73.98, 73.17, 70.73, 70.73 and 0.81%.of the *S. aureus* isolates were sensitive to chloramphenicol, Lincomycin, Ciprofloxacin, Cotrimoxazole, gentamicin, cephalothin, cephalexin, amikacin, and penicillin respectively. On the other hand, 4.88, 11.38, 11.38, 13.01, 26.02, 26.02, 26.83, 29.27 and 99.19% of *S. aureus* isolates were resistant to chloramphenicol, lincomycin, ciprofloxacin, cotrimoxazole, gentamicin, cephalothin, cephalexin, amikacin and penicillin respectively.

From these observations, it can be inferred that vancomycin and rifampin are highly potent antibiotics against majority of the *S. aureus* isolates used in this study whereas penicillin is the least effective, as almost all the *S. aureus* isolates were resistant to penicillin.

Although there is no direct evidence that the presence of microorganisms on stethoscope and other fomites directly results in infection of patients, the finding in this work are by no means trivial or inconsequential. With the increasing trend for ambulatory care of high risk patients with complex medical and surgical problems, the susceptibility of these patients' population to infections and the potential consequences thereof are very worrying.

It can also be noted that the hospital institutions studied are at a particular risk of having microbial population with high antimicrobial resistance. Further studies are in progress for plasmid profile analysis to look for the genetic loci encoding the vancomycin resistance in the strain of *S. aureus* isolates which constituted 1.63%.

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