International journal of medical sciences and academic research ISSN 2582-7197
Available at: http://scientificpublications.in/index.php/ijmsar Volume 03, Issue 05, 2022

Original Article

STAPHYLOCOCCUS AUREUS ASSOCIATED WITH ENVIRONMENTAL FOMITE AT ILE-IFE, OSUN STATE NIGERIA

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Article Received 26-09-2022 /Article Accepted 24-10-2022 / Article Published 31-10-2022

ABSTRACT

Introduction: *Staphylococcus aureus* is a pathogenic microorganism responsible for mild to life threatening infections. Fomites are being increasingly recognized as a significant means of transmission of *Staphylococcus aureus* infections. Therefore, this study determines the possible roles of cross contamination in the community environment.

Methods: A total of 50 fomite samples were obtained, 10 each from ATM key boards, Door knobs, Commercial bus steering wheel, Students' hand phones and Iron Rails in Obafemi Awolowo University's academic area. Selected fomites were sampled using a cotton swab technique. Isolates were identified as *S. aureus* using their morphological characteristics on mannitol salt agar and biochemical characteristics

Result: A total of 19 (38%) *Staphylococcus aureus* isolates was recovered from the 50 samples collected – 40% from ATM key boards, 30% from Door knobs, 40% from Commercial bus steering wheel, 20% from Iron Rails and 60% from Students' hand phones. The isolates were susceptible to Streptomycin (100%), Cotrimoxazole [Septrin] (74%), Ciprofloxacin 79% and Gentamicin 63% but resistant to Ampiclox [Ampicillin and Cloxacillin] (100%) and Pefloxacin (84%).

Conclusion: Proper hygienic practice should be promoted and avoidance of indiscriminate use of antibiotics in order to prevent the spread of resistant bacteria.

Keywords: *Staphylococcus aureus*, pathogenic microorganism,Fomites, environment.

How to Cite

J.OMOLOLU-ASO, A.BANKOLE, O.O.OMOLOLU AND O.ADESUNLORO. STAPHYLOCOCCUS AUREUS ASSOCIATED WITH ENVIRONMENTAL FOMITE AT ILE-IFE, OSUN STATE NIGERIA. **International Journal of Medical Sciences and Academic Research**, v. 3, n. 05, 31 Oct. 2022.

INTRODUCTION

Staphylococcus aureus was discovered in 1880s during which the infection commonly caused painful skin and soft tissue conditions such as boils, Scalded-Skin Syndrome, and impetigo (Ogston, 1880).

In 1940s, medical treatment of *S. aureus* infections became routine and successful with the discovery and introduction of antibiotics, such as penicillin. In the late 1940s and throughout 1950s, *S. aureus* developed resistance to penicillin (Kirby, 1994). Methicillin, a form of penicillin, was introduced to counter the increasing problem of penicillin-resistant *S. aureus*, but in 1961, British scientists identified the first strain of *S. aureus* that resisted methicillin. This was the so-called birth of Methicillin Resistant *Staphylococcus aureus* (MRSA).

Although, MRSA was identified in 1961, it was not until the mid-1980s that it became a frequent adversary. The increase in MRSA infections most likely reflects the growing impact of medical interventions, devices, older age, and comorbidities of patients (Fowler *et al*., 2005). Antibiotic use and overuse probably also contribute to the emergence of resistance. Despite constant improvement in patient care, *S. aureus* infections remain associated with considerable morbidity and mortality, both in hospitals and in the community. (Lowy, 1998).

MRSA has emerged as an important hospital-associated pathogen, because of increased morbidity and mortality rates, healthcare costs, and length of hospital stays (Nimmo and Coombs, 2008; Shorr, 2007). Hospital-associated MSRA (HA-MRSA) infections arise in individuals with predisposing risk factors, such as surgery or the presence of an indwelling medical device. In contrast, many community-acquired MRSA (CA-MRSA) infections arise in otherwise healthy individuals who do not have such risk factors, and are known to be epidemic in some countries. These features suggest that CA-MRSA are more virulent and transmissible than are traditional HA-MRSA (De Leo *et al.*, 2011).

In this study, we investigated staphylococcus aureus associated with environmental fomite at Ile-Ife, Osun state, Nigeria

MATERIALS AND METHODS

The study was carried out in Obafemi Awolowo University, Ile-Ife, Osun State, Nigeria. Swab samples were collected from different sources of fomites, all located around the academic area of the university.

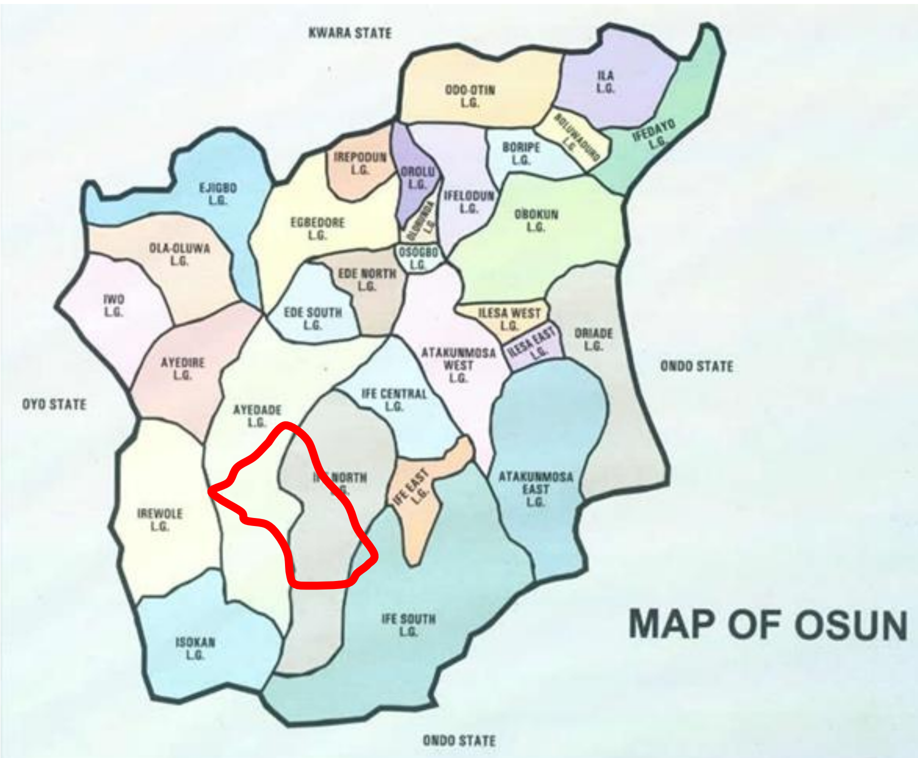

Figure 3.1a: Map of Osun state showing Ife central

Geographic Location

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Obafemi Awolowo University (OAU) is a federal government, owned and operated Nigerian university. The university is in the ancient city of Ile-Ife, Osun State, Nigeria. It is located on longitude 7.520767 and latitude 4.530315 with coordinate $7^0$31''14.7612''N and $4^0$31'49.1340''E.

Sample Population

A total of 50 samples were obtained from the university environment, respectively 10 samples from ATM keypads, Phones of students, Car steering wheels of different vehicles, Iron rails of stair cases and door knobs of different locations in the academic area.

ISOLATION, IDENTIFICATION AND CHARACTERISATION

A loop full from turbid nutrient broth containing the sample was streaked out on Nutrient Agar, and then sub-cultured on Manitol Salt Agar (for further test) until pure colonies were isolated (which showed bright golden yellow colour of fermentation on MSA after 48 hours of incubation). Gram staining, microscopy, morphological identification, catalase test, coagulase test, DNase teat, Oxidase test, sugar fermentation analysis and antimicrobial susceptibility trends of the isolate were conducted.

RESULT

Out of the 50 samples collected, total sum of 34 (68%) *Staphylococcal* isolates were recovered but 19 (38%) were confirmed as *Staphylococcus aureus*. Table 4.1 shows morphological characteristics of the isolates, Table 4.2 shows biochemical test results of the isolates, Table 4.3 shows distribution of *Staphylococci* and *Staphylococcus aureus* on sourced fomites, Table 4.4 shows antibiotic susceptibility pattern of the *Staphylococcus aureus* isolates from environmental fomites and Table 4.5 shows Frequency (%) of Antibiotic susceptibility of the *S. aureus.*

The highest rate of isolation of *Staphylococcus aureus* was obtained from Students' phones.

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Morphological characteristics of the isolates

Isolate codes	Shape	Colour	Opacity	Elevation	Gram Staining
TLP_2	Circular	Cream	Opaque	Convex	GPCC
ALP_2	Circular	Cream	Opaque	Convex	GPCC
ADP	Circular	Cream	Opaque	Convex	GPCC
CBS_7	Circular	Cream	Opaque	Convex	GPCC
SLP_1	Circular	Yellow	Opaque	Convex	GPCC
CDR	Circular	Yellow	Opaque	Convex	GPCC
SBB	Circular	Cream	Opaque	Convex	GPCC
CBS_1	Circular	Cream	Opaque	Convex	GPCC
UBM	Circular	Yellow	Opaque	Convex	GPCC
CBS_4	Circular	Cream	Opaque	Convex	GPCC
ALP_1	Circular	Cream	Opaque	Convex	GPCC
ABW	Circular	Cream	Opaque	Convex	GPCC
TLP_1	Circular	Yellow	Opaque	Convex	GPCC
CBS_5	Circular	Cream	Opaque	Convex	GPCC
SBS	Circular	Cream	Opaque	Convex	GPCC
FLD	Circular	Cream	Opaque	Convex	GPCC
OHD	Circular	Cream	Opaque	Convex	GPCC
DOD	Circular	Cream	Opaque	Convex	GPCC
OHR	Circular	Cream	Opaque	Convex	GPCC

KEY: GPCC- Gram positive clustered cocci, TLP2 - Torimiro Student's Phone 2, ALP2 - Awojobi Student's Phone 2, ADP- Adeyemo Student's Phone 2, CBS7-Commercial Bus Steering 7, SLP1- Shittu Student's Phone 1, CDR-Chemistry department stair case rail, SBB-Sky bank banking area ATM, CBS1-Commercial Bus Steering 1, UBM- Union Bank ATM, CBS4- Commercial Bus Steering 4, ALP1- Awojobi Student's Phone 1, ABW- Access bank white house ATM, TLP1- Torimiro Student's Phone 1, CBS5- Commercial Bus Steering 5, SBS- Sky Bank SUB ATM, FLD- First bank lecture theatre door knob, OHD- Oduduwa hall door knob, DOD- Department of microbiology door knob, OHR- Oduduwa hall stair case rail.

Biochemical test results of the isolates

Isolate codes	Catalase	Coagulase	Dnase	MSA
TLP_2	+	+	+	F
ALP_2	+	+	+	F
ADP	+	+	+	F
CBS_7	+	+	+	F
SLP_1	+	+	+	F
CDR	+	+	+	F
SBB	+	+	+	F
CBS_1	+	+	+	F
UBM	+	+	+	F

CBS_4	+	+	+	F
ALP_1	+	+	+	F
ABW	+	+	+	F
TLP_1	+	+	+	F
CBS_5	+	+	+	F
SBS	+	+	+	F
FLD	+	+	+	F
OHD	+	+	+	F
DOD	+	+	+	F
OHR	+	+	+	F

KEY: Positive (+), Negative (-), Fermenter (F)

Distribution of *Staphylococci* and *Staphylococcus aureus* on sourced fomites

Fomites	Staphylococcal Incidence	Staphylococcal Percentage Occurrence	Staphylococcus aureus Incidence	Staphylococcus aureus Percentage Occurrence
ATMs (n=10)	7	70%	4	40%
Car Steering Wheels(n=10)	4	40%	4	40%
Stair-case Rails(n=10)	7	70%	2	20%
Phones(n=10)	9	90%	6	60%
Door knobs(n=10)	7	70%	3	30%

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Antibiotic susceptibility pattern of the *Staphylococcus aureus* isolates from environmental fomites

Isolate codes	S	SXT	E	PEF	CN	APX	CEU	AM	CET	CPX
TLP_2	S (21)	S (23)	I (17)	R (20)	R (12)	R (0)	S (21)	I (15)	R (16)	I (20)
ALP_2	S (22)	S (23)	I (16)	R (22)	I (13)	R (0)	S (24)	I (14)	R (17)	S (26)
ADP	S (20)	S (22)	I (15)	R (23)	S (17)	R (0)	I (16)	R (0)	R (18)	S (21)
CBS_7	S (22)	S (20)	R (0)	S (26)	R (12)	R (0)	R (12)	R (0)	S (24)	I (18)
SLP_1	S (24)	S (18)	I (16)	R (21)	S (15)	R (0)	S (18)	R (0)	I (22)	S (24)
CDR	S (22)	S (18)	I (16)	S (24)	I (14)	R (0)	S (19)	R (13)	S (23)	S (24)
SBB	S (22)	S (18)	I (16)	R (20)	S (17)	R (0)	I (17)	R (0)	S (23)	I (19)
CBS_1	S (18)	S (22)	I (18)	R (22)	S (16)	R (0)	R (13)	R (0)	R (13)	S (25)
UBM	S (19)	S (21)	I (15)	R (21)	S (21)	R (0)	S (28)	I (14)	I (22)	I (19)
CBS_4	S (18)	S (18)	I (18)	S (26)	I (13)	R (0)	S (20)	I (16)	I (20)	S (22)
ALP_1	S (22)	I (15)	I (18)	R (23)	S (20)	R (0)	R (0)	R (0)	R (16)	S (21)
ABW	S (23)	S (23)	I (18)	R (20)	S (17)	R (0)	S (20)	I (17)	I (22)	S (22)
TLP_1	S (21)	S (18)	I (17)	R (18)	R (12)	R (0)	S (20)	R (0)	R (16)	S (23)
CBS_5	S (23)	R (0)	R (0)	R (23)	S (16)	R (0)	I (17)	R (0)	R (18)	S (23)
SBS	S (18)	R (0)	I (14)	R (20)	R (0)	R (0)	S (23)	I (14)	I (21)	S (21)
FLD	S (22	I (15	I (15	R (20	S (22	R (0)	I (17)	I (14	I (22	S (23)

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	)	)	)	)	)			)	)	
OHD	S (24)	I (13)	I (18)	R (21)	S (21)	R (0)	S (24)	R (0)	I (21)	S (22)
DOD	S (21)	S (19)	I (16)	R (21)	S (23)	R (0)	S (18)	R (0)	R (18)	S (24)
OHR	S (22)	S (23)	R (12)	R (23)	S (23)	R (0)	I (15)	I (13)	S (24)	S (21)

KEY: S- Streptomycin, CEU- Cefuroxime, SXT- Septrin, AM- Amoxicillin, E- Erythromycin, CET- Ceftriaxone, PEF- Pefloxacin, CPX- Ciprofloxacin, CN- Gentamycin, APX- Ampiclox.

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Frequency (%) of Antibiotic susceptibility of the S. aureus

Antibiotics	Potency of disc	Resistance	Intermediate	Susceptible
Streptomycin	30 µg	0%	0%	100%
Septrin	30 µg	10%	16%	74%
Erythromycin	10 µg	16%	84%	0%
Pefloxacin	10 µg	84%	0%	16%
Gentamicin	10 µg	21%	16%	63%
Ampiclox	30 µg	100%	0%	0%
Cefuroxime	20 µg	58%	26%	16%
Amoxicillin	30 µg	58%	42%	0%
Ceftriaxone	25 µg	42%	37%	21%
Ciprofloxacin	10 µg	0%	21%	79%

DISCUSSION

In this study, the prevalence rate of *Staphylococcus aureus* on mobile phones was discovered to be 60%. This result is in line with the findings of Sanjib *et al.* (2018), which reported an occurrence of 56% on mobile phones. High occurrence is reported in Hand held phones due to the fact that it is an indispensable tool of communication, both at home and at work. They are always picked, dropped or pocketed, therefore possessing the potential of acquiring microbes from the handlers and the environment.

The 20% occurrence of *S. aureus* in this study is exacted to that of Thongchai *et al.* (2018), who also discovered 20% occurrence on stair case rails. The occurrence is low due to the fact that the stair cases are wide enough for people to pass without holding their hands against the rail, thereby, limiting contamination of the Iron rails.

This study revealed that *Staphylococcus aureus* is 40% prevalent on ATM in Obafemi Awolowo University, Ile-Ife, Osun state. Mbajiuka, (2015) also observed a closely related prevalence of 43.4%. This should be a concern to bank operators and ATM users as there is a high tendency of cross contamination- Users come from different locations or places of work, having held different forms of equipment or substances without sanitizing or at least washing their hands before operating the ATM.

In this study, an occurrence of 30% was observed for door handles, which is in line with the 26% prevalence reported by Grace *et al.* (2017) on the prevalence of *Staphylococcus aureus* in Nasarawa State University and Omololu-Aso *et al.* (2017) which reported 25% *Staphylococcus aureus* prevalence in door handles of hospital setting in Ile-Ife, Osun state.

A study in India carried out by Vinodkumar *et al.* (2017) found a prevalence rate of 36% of *Staphylococcus aureus* in car steering. This finding closely agrees with the prevalence rate reported in this study which is 40%. This is justifiable base on the fact that commercial bus drivers are mostly unlearned individuals and whose understanding about hygiene is relatively low, being less concerned about the upkeep of their vehicles.

The *Staphylococcus aureus* isolates of this study was susceptible to Streptomycin (100%), Cotrimoxazole [Septrin] (74%), Ciprofloxacin 79%, Gentamicin 63%, which is similar to that of Omololu-Aso *et al.* (2011) and Enass, (2015). But resistant to Ampiclox [Ampicillin and Cloxacillin] (100%) and Pefloxacin (84%) with similar occurrence as described by Omololu, (2017). From the susceptibility test conducted, the *Staphylococcus aureus* isolates can be treated effectively with Streptomycin but with strict adherence to doctor's prescription to avoid resistance by the organism

CONCLUSION

This study on *Staphylococcus aureus* in Obafemi Awolowo University has proved that environmental fomites serve as reservoir and route of microbial dissemination in disease outbreak and also revealed the poor standard of hygiene, especially, hand washing among the people.

It should be noted that *Staphylococcus aureus* is just one out of millions of other microorganisms that may colonize the same surface at the same time. These therefore implies that it is possible to be infected with different other microorganisms with greater virulence.

RECOMMENDATION

I recommend that proper hygienic practice should be promoted and adherence to antibiotic treatment in order to prevent the spread of resistant bacteria. This should be considered as a timely warning and proactive measures, which if adhered to, would help to prevent an outbreak of epidemics that could become difficult to handle.

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