



## Original Research Paper

# Epidemiology of *Staphylococcus aureus*, as a cause of wound infections in Ondo State and its Antibiogram

A.A. Ademokoya

Department of Microbiology, Adekunle Ajasin University, Akungba-Akoko, Ondo State, Nigeria.

\*Corresponding Author. E-mail: a.ademokoya@yahoo.com.

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### ABSTRACT

**Background:** Epidemiology of *Staphylococcus aureus*, as a cause of wound infections in Ondo State and its antibiogram was investigated in this study. The organism is gram-positive cocci arranged in irregular, grape like clusters; they are normally present on human and animal skin where most of them live as commensal. This study is therefore designed to investigate the rate of occurrence of *S. aureus* among the traumatic patients and the antibiotics that can be adequate for the treatment of the disease it caused.

**Methods:** Swab samples were collected from patients attending primary, secondary and tertiary health care centers in the State. Two hundred samples were collected and brought to Adekunle Ajasin University's Microbiology Laboratory and subjected to standard microbiological analysis for the identification of the pathogen. Sensitivity of the organism to commercially available antibiotics was done after the organism was prepared for pure culture using agar diffusion technique. For the study data, one way ANOVA was done using statistical software SPSS Version 20.

**Results:** A 50% rate of infection with *S. aureus* was detected from this study out of 200 samples examined, and the organism was more frequent in males 60 (30%) than females 40 (20%). Concerning the lesions from which samples were collected, the following percentages of *S. aureus* were isolated from each of the lesion: trauma 20 (50%), burns 16 (40%), abscesses 18 (45%), boils 22 (55%) and wounds 24 (60%), respectively. Moreover, the organism was sensitive to the test antibiotics in a descending order as follows: gentamycin (78%), streptomycin (32%), ceporex (18%), tarivid (17%), peflacin (17%), ciprofloxacin (17%), augmentin (6%), nalidixic acid (3.5%), ampicillin (3.5%) and septrin (0%).

**Conclusion:** This study showed that 50% of wound infections in Ondo State were caused by *S. aureus* and that the organism displayed multiple resistances to all the antibiotics except gentamycin which mediated 78% effectiveness against the organism. However, in case of an outbreak, gentamycin can be used for treating infection caused by the pathogen. It is therefore suggested that effort should be reinforced at coming up with control strategy to prevent the infection from attaining epidemiological status.

**Key words:** Epidemiology, *Staphylococcus aureus*, antibiogram.

## INTRODUCTION

*Staphylococcus aureus* was first identified in 1880 in Aberdeen, Scotland, by the surgeon Sir Alexander

Ogston in pus from a surgical abscess in a knee joint (Becker *et al.*, 2003). *S. aureus* secrete molecules that

also enhance the formation of abscesses (Tokajian, 2014). These molecules include those that attract neutrophil, result in host cells lysis and are contribute to the formation of the fibrin capsule surrounding the abscess (Tokajian, 2014). *S. aureus* is a Gram positive bacterium most frequently isolated from human specimens (Ademokoya and Adebolu, 2005). They are normally present in skin, where most of them live as commensal (Ademokoya *et al.*, 2009). Most strains live as opportunists, colonizing tissues when a person acquires minor or major injuries. Their invasive ability is proportional to their ability to produce the enzyme coagulase which also is the major characteristic the strains are differentiated (Ademokoya *et al.*, 2012). *S. aureus* is a major human pathogen that causes a wide range of clinical infections. It is a leading cause of bacteremia and infective endocarditis as well as osteoarticular, skin and soft tissue pleuropulmonary, and device-related infections (Becker *et al.*, 2003) *Staphylococci* lead the cause of wound infections, both surgical and accidental (Ademokoya *et al.*, 2015). These organisms are pyogenic, meaning that they characteristically cause the production of a purulent discharge, otherwise known as pus (Eugene *et al.*, 2004). Infection with this organism usually causes an inflammatory reaction, with swelling, redness, and pain, when infection spread in general circulation it results to fever which is the prominent symptom (Betty *et al.*, 2007). Wound infections by some strains produce the toxic shock syndrome, with high fever, muscle aches, and life-threatening shock, sometime accompanied by a rash and diarrhea. *S. aureus* is an outspread bacterium and pathogen. Roughly 50% to 60% of people are permanently colonized with *S. aureus* and therefore, there is relatively high rate for infection. For example, most community-associated infection in the United States are the ones that affect skin and soft tissues (Tokajian, 2014). According to the report of (Tokajian, 2014), military personnel, 4% to 60% ultimately acquire a skin and soft tissue infection, and 91% of these infections are caused by *S. aureus* (Jarraud and Peyrat, 2001). An estimated 20% of the human populations are long-time carrier of *S. aureus* (Ryan and Ray, 2004). In the report of (Cole *et al.*, 2001), each year 500,000 patients in hospitals of the United States contract a Staphylococcal infection chiefly *S. aureus* (Dinges *et al.*, 2000, Kluytmans *et al.*, 1997).

The most useful identifying characteristic of *S. aureus* is that it produces coagulase which is not an enzyme but an extracellular protein released by the bacterium (Cole *et al.*, 2001). In the report of (Ryan and Ray, 2004), clumping factor protein is a virulence factor of *S. aureus* because it attaches to fibrinogen and fibrin present in wounds, thus aiding colonization of wound surfaces (Mathew *et al.*, 1997). Other virulence factors possessed by *S. aureus* that aid colonization of wound include binding proteins for fibronectin, fibrin, fibrinogen and collagen (Dinges *et al.*, 2000). According to (Jarraud and Peyrat, 2001), *S. aureus* virulence factors such as

clumping factor, coagulase and protein "A" serve to coat the organisms with host proteins giving them a disguise that hides them from attach by phagocytes and the immune system, and this may probably explain why immunity to *S. aureus* infection is generally weak or non-existent.

The treatment of choice of *S. aureus* infection is penicillin (Ademokoya *et al.*, 2009). It is an antibiotic derived from *Penicillium* fungus; penicillin inhibits the formation of peptidoglycan cross-linkages that provides the rigidity and strength in a bacterial cell wall (Jarraud and Peyrat, 2001). In most countries, however, penicillin resistance is extremely common, and first-line therapy is most commonly a penicillinase-resistant  $\beta$ -lactam antibiotic (for example, oxacillin or flucloxacillin, both of which have the same mechanism of action as penicillin) (Gillet *et al.*, 2002). In view of the above, there is therefore the need to prevent the spread of the disease caused by this pathogen. This study is therefore designed to investigate the rate of occurrence of *S. aureus* among the traumatic patients and the antibiotics that can be adequate for the treatment of the disease it caused.

## MATERIALS AND METHODS

Two hundred swab samples were collected from patients with wounds, boils, abscesses, burns and trauma in tertiary, secondary and primary health care centers in Ondo State. The samples were brought to the laboratory and cultured on blood agar, MacConkey agar and salt Mannitor agar. Colonies of the latter medium were subjected to biochemical tests including Gram stain, glucose fermentation, catalase, and coagulase production. Coagulase positive isolates were subjected to sensitivity test according to the method of (Ademokoya and Adebolu, 2005). Pure culture of *S. aureus* in broth was prepared. Mueller Hinton agar (Lab M Limited, United Kingdom) was prepared and purred into sterile Petri-dishes and allowed to solidify. The plates were seeded with pure isolates of the organism, antibiotics discs was placed on the plates and incubated uninverted at 37°C for 24 hours. Zones of inhibition around the antibiotics discs were measured in millimeter. This investigation was analyzed statistically using one way ANOVA (CRD)

## RESULTS

The result of the occurrence of *S. aureus* as the cause of wound infection among the traumatic patients based on sex is showed in Table 1. The organism was more frequent in males 60 (30%) than the females gender 40 (20%) out of 200 samples examined.

The frequency of occurrence based on sampled lesions can be seen in Table 2. The percentage occurrence was highest among individuals with wound

**Table 1.** Rate of occurrence of *Staphylococcus aureus* infection among the traumatic patients in Ondo State based on sex.

Sex	Number of sample collected	Number positive	% positive
Male	100	60 <sup>a</sup>	60.0
Female	100	40 <sup>b</sup>	40.0
Total	200	100	50.0

Mean with different alphabetical subscript are significantly different P<0.5.

**Table 2.** Rate of occurrence of *Staphylococcus aureus* infection among the traumatic patients in Ondo State based on sampled lesions.

Body lesion	Number of sample collected	Number positive	% positive
Trauma	40	20 <sup>a</sup>	50.0
Burns	40	16 <sup>b</sup>	40.0
Abscesses	40	18 <sup>c</sup>	45.0
Boils	40	22 <sup>d</sup>	55.0
Wounds	40	24 <sup>e</sup>	60.0
Total	200	100	50.0

Mean with different alphabetical subscript are significantly different P<0.5

**Table 3.** Rate of occurrence of *Staphylococcus aureus* infection among the traumatic patients in Ondo State based on health institution visited.

Health center	Number of sample collected	Number positive	% positive
Primary health center	74	50 <sup>a</sup>	68.0
Secondary health center	66	30 <sup>b</sup>	46.0
Tertiary health center	60	20 <sup>c</sup>	33.0
Total	200	100	50.0

Mean with different alphabetical subscript are significantly different P<0.5

infections (60%), followed by individuals with boil infections (55%), followed by patients with trauma (50%), Followed by patients with abscess (45%). While the lowest occurrence was found among individuals with burns (40%).

Moreover, Table 3 showed the frequency of occurrence based on the health institutions visited. The highest rate of occurrence was found among the patients attending primary health center (68%), followed by the individuals attending secondary health center (46%). The lowest occurrence was found among individuals attending tertiary health center (33%). Rate of occurrence based on the senatorial district residence by individual patient is shown in Table 4. The highest occurrence was found among the individuals resident in north senatorial district (81%), followed by those living in south senatorial district (33%). The lowest occurrence was found in the central senatorial district of the State. Concerning antibiotic sensitivity pattern of the pathogen, 78% were sensitive to gentamycin, 32% were sensitive

to streptomycin, 18% were sensitive to ceporex, 17% were sensitive to tarivid, peflacine and ciprofloxacin respectively, 6% were sensitive to augmentin, 3.5% to nalidixic acid and ampicillin.

## DISCUSSION

The epidemiology of *S. aureus* as a cause of wound infections in Ondo State, and its antibiogram was carried out in this study. From the study, a 50% rate of infection was detected; this result was higher than that reported in Ondo State which was 30% by (Ademokoya and Adebolu, 2005), the one reported in Adekunle Ajasin University Akungba Akoko, Ondo State, Nigeria by (Ademokoya *et al.*, 2009) which was 27.5%. The discrepancy may be due to; the type of sample examined the time frame the study was conducted, and the hygienic practices of individual and the communities at large. For instance, the work done by (Ademokoya *et al.*

**Table 4.** Rate of occurrence of *Staphylococcus aureus* infection among the traumatic patients in Ondo State based on senatorial district.

Senatorial district	Samples collected	Number positive	% positive
Ondo North	74	60	81
Ondo Centre	66	20	30
Ondo South	60	20	33
Total	200	100	50

**Table 5.** Percentage of isolates that were sensitive to different antibiotics.

Antibiotics	No. of isolates that were sensitive	% sensitivity
Gentamycin	60	78
Streptomycin	24	32
Ceporex	15	18
Tarivid	12	17
Peflacin	12	17
Ciprofloxacin	12	17
Augmentin	5	6
Nalidixic acid	2	3.5
Ampicillin	2	3.5
Seprin	0	0

,2015) was carried out in 2015, and on samples from nasal organ. The highest rate of infection recorded among the patients attended primary health institution may be due to the team population of patients patronizing the primary health care than that of secondary and tertiary health care. In addition to this, primary health institutions most of the time is more proximal to citizens than secondary and tertiary health institution. For instance, in Ondo State, only one tertiary health institution is available for the people whereas, primary health care such as Maternity is very common in every town and villages and their services is not as costly as that of tertiary health institutes.

Moreover, the higher rate of infection recorded among the male gender is in accordance with (Ademokoya *et al.*,2012) that most of the males live a carefree live and do not observe strict hygienic practices such as washing of hands before eating or in between meals. Furthermore, the infection rate was also found to be highest among the patients with wounds infection than any other body lesion this is in accordance with (Kluytmans *et al.*, 1997) that *S. aureus* is the major causes of wound infection. In this study, the highest rate of infections was also recorded among the patients living in Ondo North Senatorial District (ONSD) this could be due to the size of samples collected from this region. Seventy four swab samples were collected from (ONSD), sixty six swab samples were collected from (OCSD), and sixty swab samples were collected from (OSSD).

Concerning antimicrobial sensitivity pattern of the organism, the results showed that this organism is resistant to all the antibiotics used except gentamycin that mediated 78% effectiveness against the pathogen. This is grave, because this implies that if there is an outbreak of the infection, only gentamycin can be used for therapeutic purposes. In addition to this, only trained health personnel can handle this because gentamycin cannot be administered orally, if there is an outbreak of *S. aureus* in rural community where health facilities are rare, the teeming population there will be highly susceptible to the infection. Effort therefore should be ensured to prevent the outbreak of infection with this organism. Table 5

### Conclusion and Recommendation

*S. aureus* has been found to cause wound infection in Ondo State and that gentamycin is the only antibiotic that mediated effectiveness against the pathogen. There is therefore the need to educate the people on the importance of hygienic practices in ways of living in order to prevent infection by the organism. Moreover, large sample size would have been used and Polymerase Chain Reaction or molecular characterization would have been done to authenticate the strains of the *S. aureus* isolated in this study.

## REFERENCES

- Ademokoya AA, Adebolu TT (2005). Nasal carriage of *Staphylococcus aureus* among the staff of Adekunle Ajasin University, Akungba Akoko, Ondo State. *Journal of Applied Sciences*. 8(2): 4701-4705.
- Ademokoya AA, Atanlogun B, Adebolu TT (2009). Epidemiological survey of cloxacilin resistant strains of *Staphylococcus aureus* among apparently healthy staff and students of Adekunle Ajasin University, Akungba Akoko, Ondo state. *Journal of Applied Sciences*. 12(1): 8315-8319.
- Ademokoya A A, Adebolu TT, Oladunmoye MK (2012). The antibiogram and role of antibody in prophylaxis of albino rats against diarrhoea caused by *Escherichia coli* O17:H7. *Journal of Clinical Immunology and Immunopathology Research*. 4(3): 29-33
- Ademokoya AA, Adebolu TT, Oladunmoye MK (2015). Carrier rate of *Escherichia coli* O157:H7 among apparently healthy people in Ondo State and its antibiogram. *Int. Journal of Medical Investigation*. 4(3): 293-298.
- Eugene WN, Denise GA, Evans CR, Nancy NP, Martha TN, David H (2004). *Microbiology. A Human Perspective*. Fourth Edition. Martin J. Lange: Publisher. 788.
- Betty AF, Daniel FS, Alice SW (2007). *Balley and Scott's Diagnostic Microbiology*. Twelfth Edition. Andrew Allen Publisher: 120-125.
- Kluytmans J, VanBelkum A, Verbrugh H (1997). Nasal carriage of *Staphylococcus aureus*: epidemiology, underlying mechanism, and associated risk. *Journal of Clinical Microbiology*. 8 (6): 505-20.
- Cole AM, Tahk S, Oren A, Yoshioka D, Kim YH, Park A, Ganz T (2001). Determinant of *Staphylococcus aureus* nasal carriage. *Journal of Clinical Diagnostic Immunology*. 8(6): 1064-9.
- Ryan KJ, Ray CG (2004). *Sherris medical microbiology* 4<sup>th</sup> edition. Mc Crow Hill publisher. 8385-8529.
- Mathew KR, Roberson J, Gillespie BE, Luther DA and Oliver SP (1997). Identification and differentiation of coagulase-negative *Staphylococcus aureus* by Polymerase Chain Reaction. *Journal of Food Protection*. 60(6): 686-8.
- Dinges MM, Orwin PM, Schlievert PM (2000). Exotoxins of *Staphylococcus aureus*. *Journal of Clinical Microbiology Review*. 13(1): 16-34.
- Jarraud S, Peyrat MA (2001). Egc, a highly prevalent operon of enterotoxin gene, forms a putative nursery of super antigens in *Staphylococcus aureus*. *Journal of Immunology*. 166(1): 669-77.
- Becker K, Friedrich AW, Lubritz G, Weilert M, Peters G, VonEiff C (2003). Prevalence of genes encoding pyrogenic toxin super antigens and exfoliative toxins among strains of *S. aureus*. Isolated from blood and nasal specimens. *Journal of Clinical Microbiology*. 41(4): 1434-9.
- Gillet Y, Issartel B, Vanhems P (2002). Association between *S. aureus* strains carrying gene for Pantone valentine leukocidin and highly lethal necrotizing pneumonia in young immunocompetent patients. *Lancet*. 359(9308): 753-9.
- Tokajian S (2014). New epidemiology of *Staphylococcus aureus* infection in the Middle East. *Clinical Microbiology infection* 20(7): 624-8.

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