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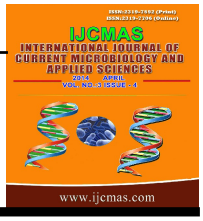

Original Research Article

Carrier rate of *Staphylococcus aureus* among residents of calabar municipality, Nigeria

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A B S T R A C T

A total of five thousand (5000) persons of different occupational groups in Calabar Municipality were investigated for nasal and skin carriage of *Staphylococcus aureus*. Two thousand, three hundred (2,300) persons were hospital staff from University of Calabar Teaching Hospital, (UCTH),General Hospital, Calabar and Hanna Foundation Clinic and Trauma Calabar. Two thousand seven hundred (2,700) were from the general public. Out of the total number investigated two thousand, four hundred and fifty (3450) were *Staph aureus* carriers. This is a 49% carriage rate of *Staph aureus*. The break down for the hospital staff carriage rates are as follows: One thousand, two hundred (52%) out of 2300 persons from the hospitals staff were carriers of *Staph aureus* while 1250 (49%) out of 700 persons from the general public were also carriers of *Staph aureus.* The carriage rates of different categories of workers in the hospitals were 350 (58%) out of 600 medical doctors, 450 (64%) out of 700 nurses, 250(50%) out of 500 laboratory staff, 100 (33%) out of 300 pharmacy staff and 50 (25%) out of 200 other hospital workers. The results obtained showed higher prevalence of *Staph aureus* in the nose 1700 (61%) out of 2800 than from the skin, 750 (34%) out of 2,200.

Introduction

The carriage of *Staphylococcus aureus* by health persons was first described by Hallman (1937) and has since been studied intensively. Repeated swabbing of the same population of normal persons yielded cumulative carriage rates of 60 – 90%. Twenty to thirty percent of the people are persistent carriers, 30 – 70% are intermittent or occasional carriers, and 10 – 40% are never carriers (Williams, 1963).

Persistent carriers usually harbour the same strains for many months or even for years. Some intermittent carriers are examples of short term persistent carriage of a single strain which is then lost, but others are truly intermittent carriers of the same strain over a long period of time (Geoffrey and Charles, 1990).

Staphylococcus aureus is among the hardest non-spore forming bacteria and it can survive many non-physiologic environmental conditions. It can be cultured from dried clinical materials after several months, is relatively heat resistant and can tolerate high salt environment. It is therefore not surprising that despite the availability of potent antimicrobial agents and improved public health conditions, *Staphylococcus aureus* has remained a major human pathogen that colonizes and infects both hospitalized patients with decreased host defenses and healthy immunologically competent people in the community. Many neonates and most children and adults become intermittently colonized by *Staph aureus* and harbour the organisms either in their nasopharynx or on their skin and clothing, or more rarely in the colon and vagina.

From these sites, *Staph aureus* can contaminate animate and inanimate objects which themselves can favour interpersonal transfer by direct contact or air transmission. The suggestion that there are "epidemic" strains of *Staph aureus* was first made in pre-antibiotic days in connection with neonatal sepsis. Attention was drawn to a number of these strains by their ability to cause the exfoliate type of skin lesion. The early antibiotic-resistant "hospital" strains were not particularly virulent, but in 1952, a strain that caused lesions of remarkable severity appeared in Australia and soon became generally prevalent throughout the country (Rountre 1978). This strain caused severe skin pustules in newborn babies, their mother and the nursing staff, wound infections, abscesses in deep tissues and septicaemic disease in hospital patients of all ages and epidemics of neonatal pneumonia (Johnson *et al*., 1960).

Folliculitis, impetigo, subcutaneous abscesses, osteomyelitis, respiratory infection, metastatic abscesses, enterocolitis, toxic shock syndrome and food poisoning are the common staphylococcal infections.

The recent emergence of foodborne disease outbreaks associated with S. aureus has triggered many screening programmes to identify the carriers of this organism. It is a major problem in food service industries as carriers can shed the organism into the food. It is generally believed that staphylococcus food poisoning is caused by *Staphylococcus aureus* carries. This is caused by the ingestion of food that contains the preformed toxin elaborated by enterotoxin producing strains.

Sufficient toxin is produced in four to six hours at 86^{o}F. Symptoms which appear abruptly two to six hours after ingestion of the food consist of severe cramping, abdominal pains, nausea, vomiting and diarrhea. Some patients die immediately if medication is not administered quickly. This is one of the reasons why it is necessary to screen people for carriage of the organism. Carriers of *Staphylococcus aureus* are usually not allowed to handle foods and care for new born babies in maternity wards in some countries. This study is therefore aimed at identifying healthy carriers of *Staphylococcus aureus* and if possible to advise against using these carriers in food service industries and limiting their contact with new born babies.

Materials and Methods

Permission was sought for from the Cross River State Ministry of Health to use human subjects for this study. The request was granted subject to the use of Standard ethical procedures and the acceptance of the subjects voluntarily to participate in the study.

Trained laboratory technicians and technologists were used to collect the specimens. The specimens were collected from the nose and skin of the subjects to be studied using sterilized cotton tipped swab sticks, which were presoaked in sterile peptone broth. The skin and nose of each candidate were swabbed separately with each swab stick. These were transported to the laboratory for processing. The specimens were cultured on 5% sodium chloride blood agar, 75% sodium chloride mannitol salt agar Baird-Parker agar and Staphylococcus aureus agar. The plates were incubated at 37^0C for 18 hours and up to 48 hours.

Characterization and Identification

Cultural characteristics

The colonial characteristics of the isolated colonies on the media were observed and noted.

Morphological characteristics

A thin smear of each isolate was prepared on a microscope slide, Gram stained and viewed under the microscope. The arrangement of cells, gram reaction and form were noted.

Biochemical characterization

The following biochemical tests catalase, coagulase, glucose and mannitol fermentation were done and the results noted.

Coagulase test

The suspected *S. aureus* colonies were transfered into small tubes containing 0.2-0.3 ml BHI broth and emulsified thoroughly. Agar slant of TSA was inoculated with loopful of BHI suspension. The BHI culture suspension and slants were incubated for 18-24 h at 35°C. The slant cultures were retained at room temperature for repeat tests in case coagulase test results were questionable. The 0.5 ml reconstituted coagulase plasma with EDTA was added to the BHI culture and mixed thoroughly. This was incubated at 35°C and examined periodically over 6 h period for clot formation.

Catalase test

The suspected colonies were obtained with a wire loop from TSA slant and placed on glass slide and one or two drops of hydrogen peroxide was dropped on the colonies. Production of gas bubbles under good illumination was looked for.

Anaerobic utilization of mannitol

The tube of carbohydrate fermentation medium containing mannitol was inoculated heavily with the suspected *S. aureus* colonies to the bottom of the tube. The surface of the agar was covered with a layer of sterile paraffin oil at least 25 mm thick to create an anaerobic environment. This was incubated for 5 days at 37°C. Acid production throughout the tube is looked for. Controls were run simultaneously (positive and negative cultures and medium controls)

Lysostaphin sensitivity

Isolated colonies were transfered from agar plate with inoculating loop to 0.2 ml phosphate-saline buffer and emulsified. Half of the suspended cells were transferred to another tube (13 x 100 mm) and mixed with 0.1 ml phosphate-saline buffer as control.To get concentration of 25 µg lysostaphin/ml, 0.1 ml lysostaphin (dissolved in 0.02 M phosphate-saline buffer containing 1% NaCl) was added to the original tube. Both

tubes were incubated at 35°C for not more than 2 h (Bennett and Lancette , 2001).

Results and Discussion

The results of the carriage rates of *S. aureus* on the skins and nasal passages of the studied subjects are shown in Tables 1 and 2 while the total carriage rate of the different occupational groups are shown in Table 3.

Staphylococcus aureus was present in 2430 out of the 5000 persons sampled from the different occupational groups with differences in the rate of carriage of each group as shown in table 3. it was found that the percentage of *Staph aureus* positive from the hospital group was 1200 (52%) more than the percentage of *Staph aureus* positives from the general public 1250 (46%). Among the hospital group, it was found that there were more *Staph aureus* isolates from nurses 350 (70%) followed by medical doctors 350 (58%), laboratory staff 250 (50%), pharmacy staff 100 (40%) and accounts and administrative staff 150 (33%).

The carriage rate of *Staphylococcus aureus* among healthy persons has stimulated considerable interest worldwide. This interest was centered on the spread of this organism to non-carriers and also the contamination of food by carriers. Frequent food borne diseases caused by *Staphylococcus aureus* has been associated with the handlers of the food who are carriers. Fast food restaurants and eating places are potential transmission points. The results have shown that *Staphylococcus aureus* colonized the nasal passage more than the skin among the persons sampled. This could be as a result of the nature of the skin which is washed frequently compared to the nasal passages. Also, hospital staffs have the highest carriage rate than other groups in the population sampled. Findings here are similar to those of Godfrey and Smith (1958). Among the hospital staff, it shows that the nurses are the highest carriers (70%) followed by medical doctors (58%). The high prevalence of *Staphylococcus aureus* among the nurses and medical doctors can be attributed to their degree of frequent contact with patients and clinical specimens (Guickshank 1974).

The ecological distributions, of micro-organisms in human host is related to several factors. These include alterations in environmental conditions, competition in essential nutrients ands interference in immune response of the host. These factors all play important roles in determining the indigenous microbial population at any one time (Bergquist 1981). Hares and Thomas (1956) demonstrated that *Staph aureus* were spread from the anterior nares of a carrier to the skin and clothing and thence to the surroundings. It became apparent that little dispersion of the organism occurred directly from the nose and month but was chiefly mediated via the desquamating skin (Davies and Noble 1962). It is therefore apparent that contamination of new born babies and food by *Staphylococcus aureu*s may occur through the skin and clothing of carriers. The most common pathogen that causes skin infection is *Staphylococcus aureus* as reported by Nishijama *et al.,* (1993).

It is therefore paramount that hospital workers more especially the nurses and medical doctors use well designed aseptic techniques to reduce the spread of the organism. There is also the need for self serve restaurants to put in place mechanisms to protect the food from contamination by carriers. For the food handlers, proper screening methods should be employed to screen out the potential carriers in order to avoid food borne diseases resulting from food contamination by the organism. From this study, it is apparent that hospital staff more especially the nurses and medical

doctors fall into the highest carriage group of *Staphylococcus aureus*.

The 46% carriage rate of *Staphylococcus aureus* is significant because it can lead to contamination of foods and cause food poisoning if proper screening of food handler is not done. Also, the carriage rate for nurses (70%) and medical doctors (58%) pose significant threat to patients and other workers. It can therefore be said that problems of nosocomial *S. aureus* infections could have been caused by the medical doctors and nurses working in the health care facilities

Table.1 Nasal carriage rate of *S, aureus* of different occupational groups

Occupational groups	NO. of persons nose swabbed	NO. of persons *S. aureus* positive	Percent carriage rate
Medical doctors	300	200	67
Nurses	250	200	80
Lab. Staff	250	150	60
Pharm. Staff	150	100	67
Accounts & Adam. Staff	250	100	40
General Public	1600	900	56
Total	**2800**	**1650**	**59**

Table.2 Skin carriage rate of *S. aureus* different occupational groups

Occupational groups	No. of persons skin swabbed	No. of persons S. aureus positive	Percentage carriage rate
Medical doctors	350	200	57
Nurses	250	150	60
Lab. Staff	250	100	40
Pharm. Staff	100	20	20
Accounts & Adam. Staff	200	50	25
General Public	1050	300	29
Total	**2200**	**820**	**37**

Table.3 S. aureus carriage rate of different occupational groups

Occupational groups	No. of persons examined	No. of persons *S. aureus* positive	Percent carriage rate
Medical doctors	600	350	58
Nurses	500	350	70
Lab. Staff	500	250	50
Pharm. Staff	250	100	40
Accounts & Adam. Staff	450	150	33
General Public	2700	1250	46
Total	**5000**	**2450**	49

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