

Frequency of infectious disease caused by Methicillin sensitive *Staphylococcus aureus* (MSSA) among community and hospital acquired infections in Khartoum State, Sudan

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Abstract

Background: *S. aureus* is the most common bacteria associated with both community and hospital associated infections. It is associated with skin and wound infection, pneumonia, endocarditis, septic arthritis, osteomyelitis.

Objectives: The present study aimed to estimate the prevalence of infectious disease caused by Methicillin sensitive *Staphylococcus aureus* among community and hospital acquired infections in Khartoum State, Sudan.

Methods: A cross-sectional laboratory-based study was conducted during the period from November 2020 to January 2021. To isolate and identify *S. aureus*, the conventional method and protein A latex test were used. All isolated organisms were tested for their in-vitro antimicrobial susceptibility against methicillin (MET 5µg) disc using the Kirby-Baur disk diffusion method to detect MSSA.

Result: The result showed a high frequency of community infection (80%). The majority of the isolates were isolated from patients with respiratory tract infection (28.7%), and the result showed that RTI more common on community infection (33.7%).

Conclusion: The present study concluded that male more infected by MSSA and the highest frequency of isolates was in the age group more than 45 years. The present study highlighted that RTI is predominantly the site of infection by MSSA. The present study showed that RTI more common on community infection.

Keywords: *S. aureus*; MSSA; Community infection; RTI

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1. Introduction

Staphylococci are typical Gram-positive bacteria forming irregular clusters of cocci which are widespread [1]. *Staphylococcus aureus* is a catalase-positive, coagulase-positive cocci in clusters [2]. It is a commensal and opportunistic bacterium that colonizes different parts of the body, such as skin, nostrils, axilla, and inguinal areas. Approximately 25-30% of healthy individuals are colonized with *S. aureus* [3]. Transmission of *S. aureus* can take place from one person to another by close or direct contact, sharing personal items, food contamination, and fomite contamination such as doorknobs [3, 4]. *S. aureus* colonization in different parts of the body increases the risk of infection at the surgical site, as well as the infections of the lower respiratory and blood stream in hospitals [3]. *S. aureus* is the most common bacteria associated with both community and hospital associated infections [5]. It is associated with skin and wound infection, pneumonia, endocarditis, septic arthritis, osteomyelitis [6]. And recently, urinary tract infection, endocarditis and implant-related infections [5]. It can also cause toxic shock syndrome, scalded skin syndrome and food poisoning [7]. The present study aimed to estimate the prevalence of infectious disease caused by Methicillin sensitive *Staphylococcus aureus* among community and hospital acquired infections in Khartoum State, Sudan.

2. Material and methods

2.1. Ethical clearance

The study was approved by the Ethical Committee, University of Gezira, Sudan. Written consent was obtained from every participant before he/she was enrolled in the study.

2.2. Study Design

A cross-sectional laboratory-based study was conducted during the period from November 2020 to January 2021 at Khartoum State. A total of three hundred *S. aureus* clinical isolates (n, 300) were collected from patients with different clinical signs attending different hospitals at Khartoum State, Sudan.

2.3. Phenotypic Characterization of *S. aureus*

Standard scheme for identifying all staph. Isolates was used according to [8]. These include colony morphology on: blood agar, mannitol salt agar, MacConkey agar, Gram-stain, catalase, coagulase tests, and protein A latex test.

2.4. Determination of methicillin sensitive *S. aureus*

All isolated organisms were tested for their in-vitro antimicrobial susceptibility against methicillin (MET 5µg) antibiotic using the Kirby-Baur disk diffusion method according to the CLSI [9]. 2-3 fresh colonies were suspended in 1ml nutrient broth and adjusted to 0.5 Mac Farland standard tube. The antibiotic disc which was controlled against *S. aureus* control strain (ATCC 25923). Antibiotic sensitivity disc were placed on each plate of Mueller-Hinton agar and then incubated at 37°C for 24hours. The plates were examined for zones of inhibition around antibiotic disc. These were measured and compared with an interpretive chart to determine the sensitive, and resistant strains.

2.5. Statistical analysis

Data were entered in Microsoft Excel spreadsheet 2013 and analyzed using Statistical Package for the Social Sciences (SPSS) program version 22 using Statistical Package used the chi-square test.

3. Results

3.1. Bacterial isolates

Identification of the isolates was carried out by using colony morphology on blood agar, MSA and MacConkey agar, Gram's Stain and different biochemical tests as shown in Figure (1). From three hundred (n=300) *S. aureus* clinical isolates, MSSA was detected on 115 (115/300, 38.3%).

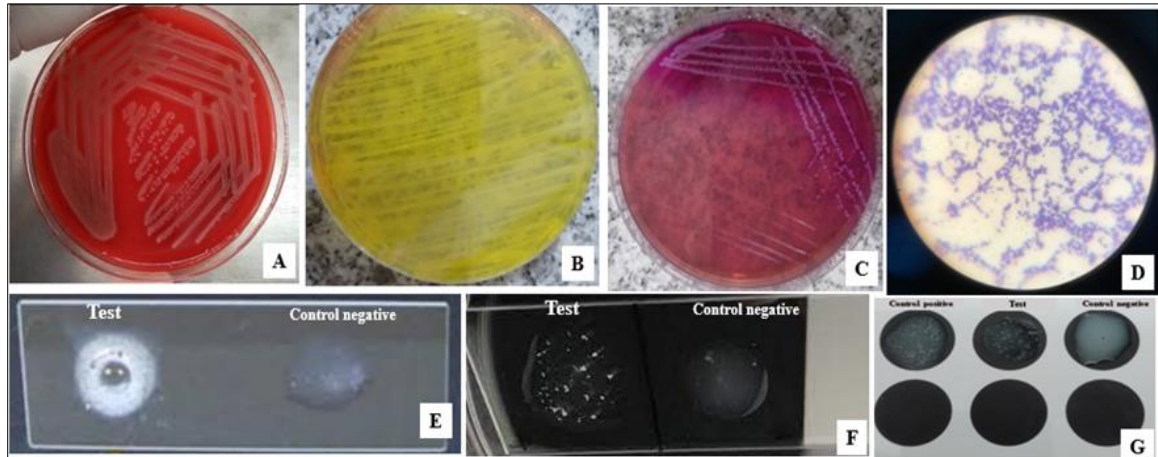


Figure 1 Conventional scheme for identification *Staph. aureus* (A); Overnight growth of *S. aureus* on a blood agar medium, which produces grey color, (B); Fermentation reaction of *S. aureus* on MSA medium, (C); Fermentation reaction of *S. aureus* on MacConkey medium, (D); *Staphylococcus aureus* under the microscope with X100 objectives with Gram reaction, (E); bubbles formation by *S. aureus* (catalase test), (F); Clumping in coagulated plasma drop by *S. aureus* (coagulase test), (G); Agglutination by *S. aureus* (protein A latex test)

3.2. Demographic Data

Different units and departments were included in the study; the majority of MSSA was isolated from the Medicine unit (42/115, 36.5%), followed by ICU (27/115, 23.5%), Surgical (20/115, 17.4%), Obs/Gyn (10/115, 8.7%) as shown in Figure (2).

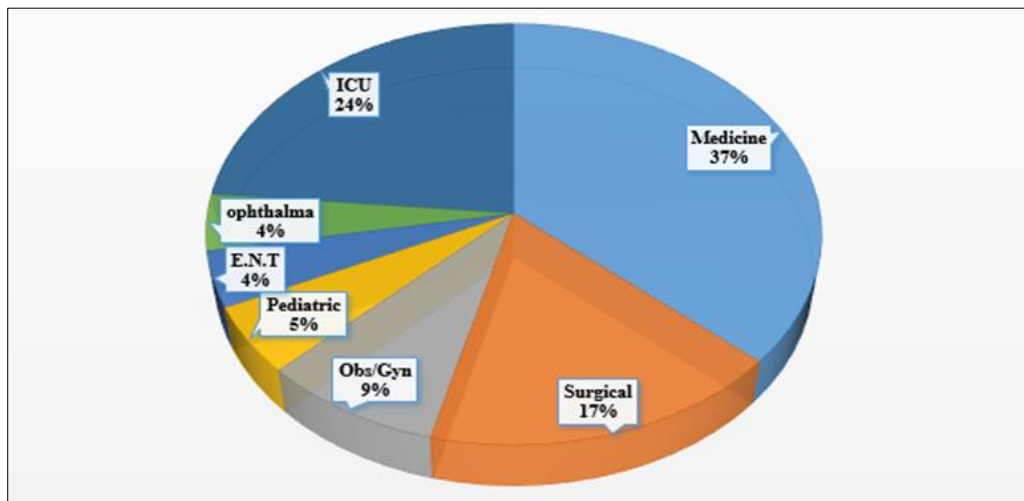


Figure 2 Distribution of MSSA isolates according to hospitals wards and units

According to demographic data, the study revealed that MSSA is more common among males (65/115, 56.5%) than females (50/115, 43.5%). The ages of patients were classified into four categories: the highest frequency was shown in the age group more than 45 years old (50/115, 43.5%) of the total MSSA studied cases, and the lowest frequency was found in the age group ≤ 16 years old (16/115, 13.9%). MSSA isolates were classified as community-acquired infection and hospital infection. Of the total 115 MSSA isolates included in this study, the result showed a high frequency of MSSA among community infections (92/115, 80%), while a low frequency was identified among hospital infections (23/115, 20%), as shown in Table (1).

Table 1 Demographic data including gender, age and type of infection

Demographics data		Frequency	%
Gender	Male	65	56.5
	Female	50	43.5
Age groups	≤16	16	13.9
	17-30	25	21.7
	31-45	24	20.9
	>45	50	43.5
Type of infection	Community infection	92	80
	Hospital infection	23	20

3.3. Distribution of MSSA According to the Source and Site of Infection

Regarding sources and site of infection, the majority of the isolates were isolated from patients with respiratory tract infection (RTI) (33/115, 28.7%) followed by different cases of septicemia (21/115, 18.3%), skin and wound Infection (21/115, 18.3%) Figure (3).

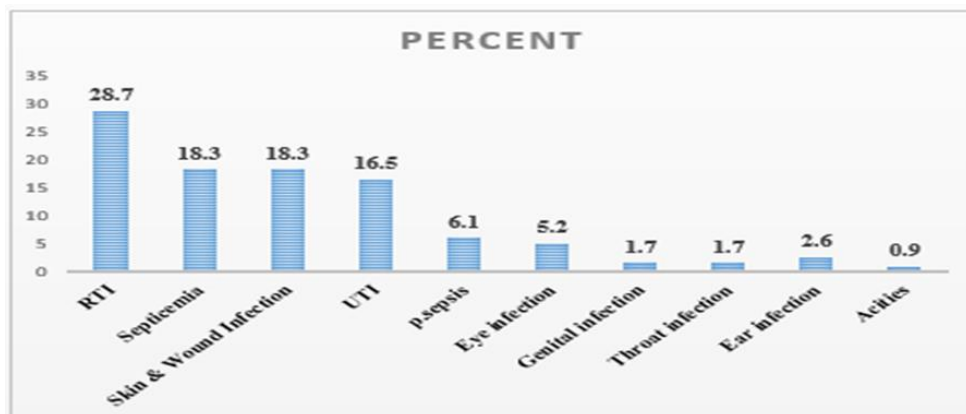


Figure 3 Distribution of MSSA according to the site of infection, X-axis show site of infection and Y-axis show percentage of site infection

Table 2 Source and site of infection against Gender

Source and site of infection	Gender		
	Male	Female	Total
RTI	27	6	33
Septicemia	15	6	21
Skin & Wound Infection	14	7	21
UTI	2	17	19
p.sepsis	0	7	7
Genital infection	0	2	2
Throat infection	1	1	2
Ear infection	1	2	3
Eye infection	4	2	6
Acities	1	0	1

In the relation between Source and site of infection versus gender as shown in table (2), the result showed that RTI more in female (27/33, 81.8%) followed by Septicemia (15/21, 71.4%), while UTI more common in female (17/19, 89.5%) followed by p.sepsis (7/7, 100%), Skin & Wound Infection (7/21, 33%).

In the relation between Source and site of infection versus age groups as shown in table (3), the result showed that RTI more in age group of >45 (28/33, 84.8%) followed by Septicemia (13/21, 62%), while UTI more common in age group 17-30 years old (13/19, 68.4%).

Table 3 Source and site of infection against age groups

Source and site of infection	Age groups				
	0-16	17-30	31-45	>45	Total
RTI	1	0	4	28	33
Septicemia	7	1	0	13	21
Skin & Wound Infection	0	5	9	7	21
UTI	1	13	4	1	19
Genital infection	0	0	2	0	2
Throat infection	0	1	1	0	2
Ear infection	3	0	0	0	3
Eye infection	4	2	0	0	6
p.sepsis	0	3	4	0	7
Acities	0	0	0	1	1

Regarding the distribution of source and site of infection among type of infection, the result showed that RTI (31/92, 33.7%) more common on community infection followed by UTI (19/92, 20.6%), Septicemia (16/92, 17.3%), while hospital infection record only four types of source of infection as follow: Skin & Wound Infection (10/23, 43.5%), p.sepsis (6/23, 26%), Septicemia (5/23, 21.7%) and RTI (2/23, 8.7%) as shown on figure (4).

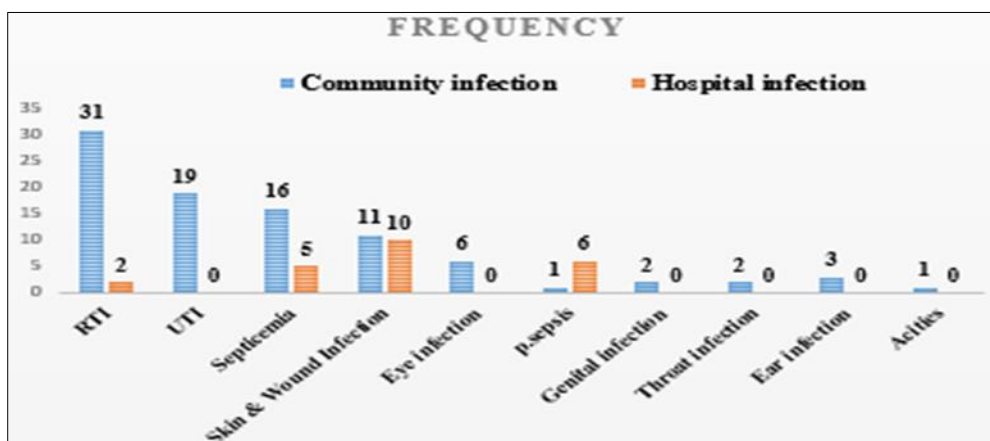


Figure 4 Source and site of infection against Type of infection, X-axis show site of infection and Y-axis show percentage of Type of infection

4. Discussion

S. aureus is one of the main pathogens in hospitals and communities that can cause many infectious diseases, such as mild skin and soft tissue infections, infective endocarditis, osteomyelitis, bacteremia, and fatal pneumonia [10, 11].

In this study our findings suggested that MSSA was represent (38.3%); this finding was in agreement with many studies: in Sudan [12] who recorded that MSSA was (39.5%), and [13] (30.6%). Other authors reported a higher frequency of MSSA than that reported in this project; in Sudan, [14] (55.4%) and in Nigeria by [15] (61.5%). On the other hand study conducted in Sudan by [16] suggested low frequency of MSSA (28.6%) comparing with our result. In the present study Different units and departments were included in the study, the highest frequency of *S. aureus* was isolated from the Medicine unit (36.5%), in contrast the study conducted in Saudi Arabia by [17] reported high frequency in ICU (39%). According to demographic and bacteriological data, the study revealed that males were found to be more infected by *S. aureus* than females, (56.5%: 43.5%), this finding is partially agreed with that reported in Saudi Arabia by [17] (60%). but other study conducted in Sudan by [14] suggested high frequency among female (55.6%).

Patients enrolled in the study were divided into four age groups. The highest frequency of isolates was in the age group more than 45 years old (43.5%) of the total patient's number harbored *S. aureus*. This result is not far from a study conducted in Khartoum –Sudan, by [18], who reported moderate percentage of *S. aureus* among his target population (37.2% in the age group of 56-70). Also, a higher frequency of *S. aureus* was observed in patients aged more than 44 years old in in Pakistan by [19] (68.4%). *S. aureus* isolates were classified as community-acquired and hospital based infection. The result showed a high frequency of community infection compering with hospital infection, (80%/20%), this result is in agree with [18] in Sudan who reported a percentage of (80%) and in agree with [20] in Egypt, who reported a percentage of (73.3 %) *S. aureus* isolates from community infection. In contrast, lower frequencies of *S. aureus* isolates from community infection was reported in Sudan by [21] (37.1%) and in Pakistan by [22] (20.8%). Distribution of *S. aureus* according to the site of infection; the predominant were respiratory tract infection (28.7%). A previous studies achieved in Nigeria by [23] found that the percentage of wound was the most prevalent (48%) and [15] also reported high frequency in wound (29.4%). Also, the result is totally disagrees with that reported in Sudan by [12], who mentioned that ear infections is the most frequent among his target group (28.5%).

In the relation between Source and site of infection versus gender our study suggested RTI more in female (81.8%), while UTI more common in female (89.5%). In this study our findings suggested RTI more common in age group of >45 (84.8%), while UTI more common in age group 17-30 years old (68.4%). Regarding the distribution of source and site of infection among type of infection, the result showed that RTI more common on community infection (33.7%), while skin and wound Infection more common on hospital infection (43.5%).

5. Conclusion

The present study concluded that male more infected by MSSA and the highest frequency of isolates was in the age group more than 45 years. The present study highlighted that RTI is predominantly the site of infection by MSSA. Distribution of source and site of infection among type of infection showed that RTI more common on community infection, while skin and wound Infection more common on hospital infection.

Compliance with ethical standards

Acknowledgments

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Disclosure of conflict of interest

The authors declare that there is no conflict of interest.

Statement of ethical approval

The Ethical approval and permission were obtained from the ethics committee of College of Medical Laboratory Science, University of Gezira, Sudan.

Statement of informed consent

Informed consent was obtained from our patient.

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