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Antimicrobial Susceptibility of *Staphylococcus aureus* isolated from Clinical Isolates of Patients in El Jalaa Hospital for Surgery and Accidents in Benghazi City – Libya

Dareen El shareef Jadullah, Microbiology, Faculty of pharmacy, Qurina International University, Benghazi– Libya,

Email: dareenelshareef@qiu.edu.ly

Abstract— ***Background: Staphylococcus aureus cause disease through the production of toxin or through direct invasion and destruction of tissue. Staphylococci have a record of developing resistance quickly and successfully to antibiotics. Objectives: To evaluate antibiotic resistance trends in Staphylococcus aureus over time. Materials and Methods: One hundred and ten consecutive isolates of S. aureus obtained from various clinical specimens between January 2022 to April 2022 sent to the Medical Microbiology Laboratory Department of El Jalaa Hospital for Surgery and Accidents in Benghazi City – Libya, and the standard procedures for bacteriology were applied to the isolates. Antibiotic sensitivity pattern was carried out by disc diffusion method. Results: In this study, among 14 (12.7%) samples from males and 96 (87.3%) samples from women suspected of having gram-positive bacteria. Most of Staphylococcus aureus isolate was from age group between (30-45 years) 36.4%. Urine isolates 97(88.2%), the highest specimen S. aureus isolates followed by swab 11(10%). The most common drug sensitivity in the S. aureus isolates were to sensitivity to gentamicin and ciprofloxacin 73 (66.4%) while the most common drug resistance was to sulfamethoxazole 54 (49.1%) and azithromycin 75 (68.2). In our study found a strong significant relationship between sex and Doxycycline antibiotic, where (p. value=0.002) and between age and Augmentin antibiotic, where (p. value = 0.038). this study was recorded a significant relationship between (age & sex) & (sex and samples) where (p. value=0.05). Conclusions: It is known that the degree of resistance or sensitivity of Staphylococcus aureus to the antibiotics used varies from one region to another, so this study is useful in guiding the experimental treatment caused by Staphylococcus aureus and helps epidemiologists understand the nature of isolates of this bacteria in this part of Libya.***

Keywords- ***Staphylococcus aureus, surgery, Hospitalized patients.***

I. INTRODUCTION

A. History:

Staphylococcus aureus is a Gram-positive, catalase positive, coagulase positive, non-motile coccus bacterium that causes a variety of human infection in all age groups (Boyce, 1981).
It is the major causative agent in surgical wound infections and epidermal skin diseases in newborn infants (Baldwin et al., 1957).

B. Diseases:

Staphylococcus aureus (S. aureus) is one of the leading causes of infections acquired in the community and after surgery or hospital. Around 30% of individuals carry S. aureus in their nose, pharynx or back of throat and on their skin. S. aureus causes numerous infections at various sites of the body. Some of these include:

1. Skin infections – S. aureus causes boils, furuncles, styes, impetigo and other superficial skin infections in humans.
2. Infections of surgical and trauma wounds – Those with chronic illness, diabetes, traumatic injury, burns or immunosuppression are susceptible to more severe skin, deeper tissue infections and deep abscesses.
3. Urinary tract infections.
4. Food poisoning and gastrointestinal tract infections may be caused by consuming food contaminated with S. aureus
5. Infections of organs include pneumonia (lung infection), osteomyelitis (bone infection),

ISSN: 2959- 7463

endocarditis (heart infection), phlebitis (infection of veins and blood vessels), mastitis (infection of breast and formation of abscesses) and meningitis (brain infections). These infections are more common in hospitalized patients rather than healthy individuals in the

C. community.

Infections from and on indwelling medical devices. These include infection of joint prostheses, cardiovascular devices and artificial heart valves. Generalized life threatening blood infections or Toxic shock syndrome (TSS), bacteremia and septicemia (Baron,1996).

D. Effect of ant1ibiotics:

Persistent suppression of bacterial growth by certain antibiotics was tested by periodic counts of viable organisms in a culture of Staphylococcus aureus that had been incubated in media containing drugs for limited periods of time and then removed by centrifugation. During short (2 hr.) periods of exposure of test cultures to penicillin G, cephalothin, erythromycin, clindamycin, vancomycin, and tetracycline, effects on the growth of S. aureus were produced that persisted after removal of the drug for periods of 1.7-4.1 hr. A persistent antibiotic effect was not observed with gentamicin. The persistent effects of penicillin G and erythromycin were directly related to duration of exposure and concentration of drug, up to a point of maximal response. The maximal durations of bacterial suppression after exposure to penicillin G and erythromycin were approximately 2 and 5 hr., respectively. These effects were observed over a wide range of inoculate (McDonald et al., 1977).

E. Aim of study:

The aim of the present study is to establish the incidence of S. aureus in clinical specimens and its antibiotic sensitivity pattern to various antibiotics in this locality. The objectives of the study were to see the susceptibility pattern of S. aureus isolates against various types of commonly used antibiotics in Al-Jalaa hospital, to determine the prevalence of Staphylococcus aureus among clinical S. aureus isolates on Kirby-Bauer disc diffusion method., in order to utilize that information to formulate antibiotic policy and appropriate control measures.

ISSN: 2959- 7463

II. METHODS AND MATERIALS

It was a cross - sectional study conducted from January 2022 to April 2022 for about 110 samples which are screened by Disc diffusion method in El Jalaa Hospital for Surgery and Accidents in Benghazi City - Libya.

A. *Source of sample collection:*

Total of 110 clinical specimens and carrier screening generally as infected and colonized patients in hospitals samples such CSF, urine, catheter tip, pus, pus swabs, sputum and surgical site infections.

B. *Identification of Staph aureus:*

All the samples were aseptically handled and processed. The morphotypes were done for all the samples based on the Gram staining method, the clinical specimens were inoculated on to blood agar, MacConkey agar and mannitol agar and incubated at 37ºC for 24 hours. All strains tested for the production of free coagulase enzyme based on standard methods (Betty et al., 2002).

C. *Statistical analysis:*

The data were analyzed by SPSS 22.

D. *Treatment:*

Antibiotic treatment varied from patient to patient. The antibiotics were used during the study period for all specimens so AMC-Augmentin (20/10 µg), IPM-Imipenem (10 µg), TCC-Ticarcillin-Clavulanate (75 µg), CX-Cefoxitin (30 µg), FEP-Cefepime (30 µg), CTX-Cefotaxime (30 µg),CRO-Ceftriaxone (30 µg), CAZ-Ceftazidime (30 µg), CL-Cephalothin (30 µg), GN-Gentamycin (10 µg), FA- Fucidic acid (30 µg), DO-Doxycycline (15 µg), AZM-Azithromycin (15 µg), AX-Amoxicillin (10 µg), OX-Oxacillin (30 µg), AM-Ampicillin (10 µg), NA- Nalidixic acid (30 µg), SXT-Sulfamethoxazole (1.25/23.75 µg), C-Chloramphenicol (30 µg), and CIP-Ciprofloxacin (5 µg), were the antibiotics that demonstrated in-vitro activity regularly against all culture organisms.

III. RESULTS AND DISCUSSION

A. *Results of socio-demographic data:*

This cross-sectional study was on a group of 110 of children and adults in the age group from 1 month to over 46 years in laboratory department of Al-Jalaa hospital for surgery & accidents from 99 urine samples, 11 swab samples.

B. *. Age group:*

The age groups in the study were between 1 day and over 46 years divided into 4 age groups, the first group (0-14) 24.5%, the second group (15-30 years) 17.3%, the third group (30-45 years) 36.4% and the fourth group (over 46 years) 21.8% as shown in the table (I) & figure (I).

TABLE I. *Distribution of age included in the study*.

Age	Percent	Frequency
0-14	24.5	27
15-30	17.3	19
30-45	36.4	40

The Cross tabulation of age & sex		
Age	**Sex**	
	Female	**Male**
0-14	24	3
15-30	17	2
30-45	33	7
Over 46	22	2
Total	96	14

ISSN: 2959- 7463

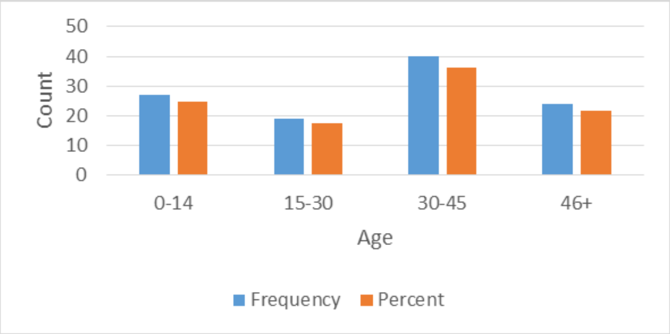


Figure I: *Distribution of age included in the study*

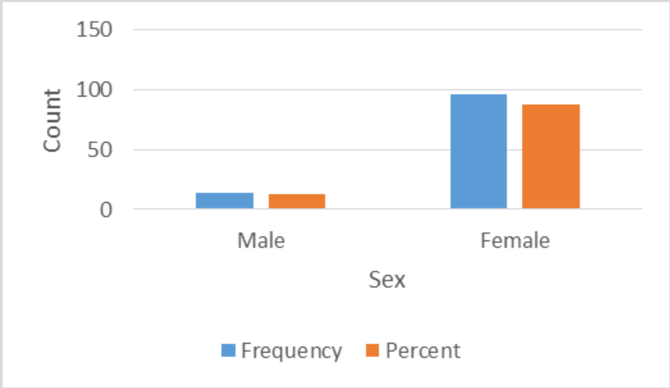


Figure II: *Distribution of sex included in the study*

C. Sex:

Among 110 investigated, different world about 14 (12.7%) were males and 96 (87.3%) were females as shown in the table (II) & figure (II).

TABLE II. *Distribution of sex included in the study*

Sex	Frequency	Percent
Male	14	12.7
Female	96	87.3
Total	110	100.0

D. The relation between the age and sex:

As results in the table investigated sex and age and as shown in the following tables (III&IV) & figure (III) that the relationship between age & sex are significant relationship, where the significant value was 0.05.

TABLE III. *The relation between the age and sex*

TABLE IV. *The relation between age & sex included in the study by chi-square tests.*

Chi-Square Tests			
Asymptotic Significance (2-sided)	**Df**	**Value**	
0.050	3	7.466 [a]	Pearson Chi-Square

ISSN: 2959- 7463

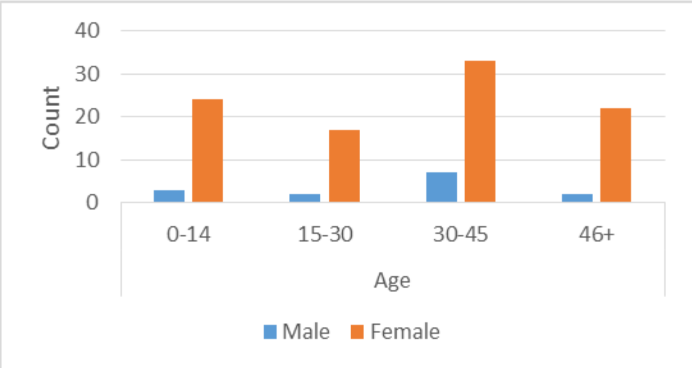


Figure III: *The relation between age & sex included in the study*

E. Culture results:

Microscopic examination for samples, gram staining and culture for bacteria for the 110 sample that was positive to culture test, found that of 100 causes positive infection urine 97(88.2%) and swab 11(10%) urine RIE 1 (0.9%) urine CLS 1 (0.9%) as shown in the table (V) & figure (IV).

TABLE V. *Microscopy and culture results.*

Samples	**Frequency**	**Percent**
Urine	97	88.2
Swab	11	10.0
Urine RIE	1	0.9
Urine CLS	1	0.9

Total	110	100.0

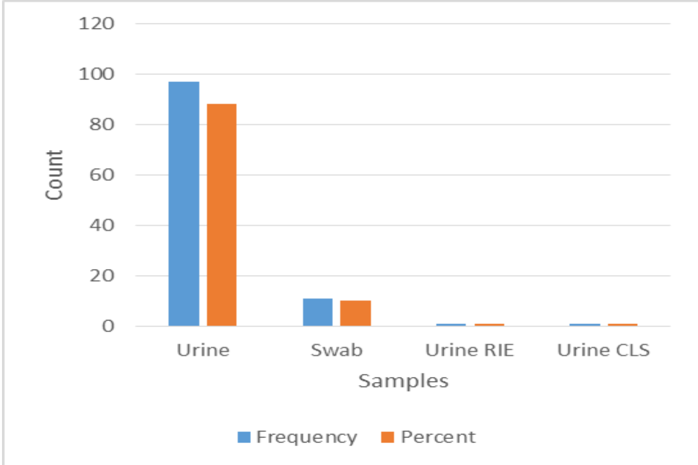


Figure IV: *Microscopy and culture results*

Gram stain of Staphylococcus aureus:

As show in the figure (IV) these from we shown that the Staphylococcus aureus is gram positive.

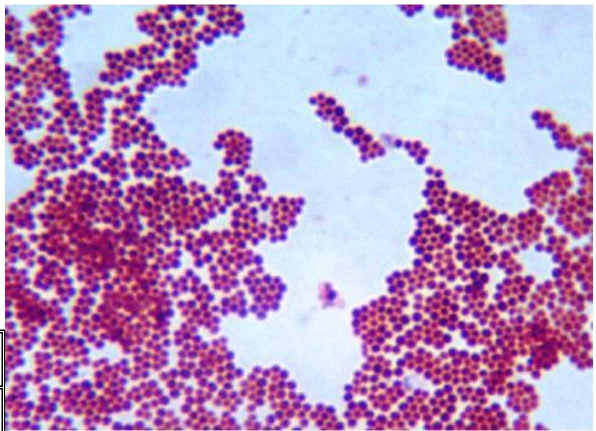


Figure (V): *The gram stain of Staphylococcus aureus.*

The growth of Staphylococcus aureus on Macconkey agar:

ISSN: 2959- 7463

In the figure (VI) shows the growth of *Staphylococcus aureus* gram.

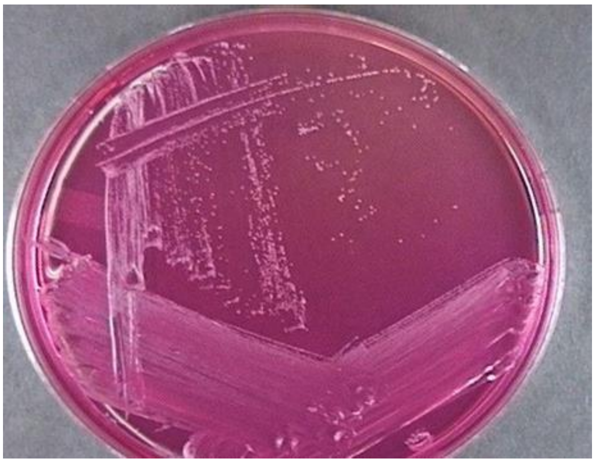
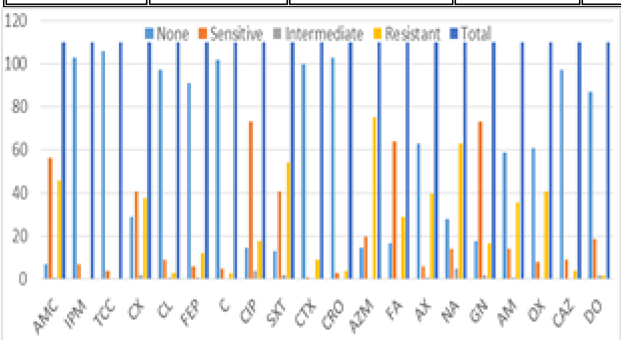


Figure (VI): *The growth of Staphylococcus aureus on Macconkey agar*

The effects of antibiotics on Staphylococcus aureus:

The table (VI) & the figure (VII) showed that the more sensitive antibiotics to the *Staphylococcus aureus* is GN-Gentamycin and CIP-Ciprofloxacin, and more resistant antibiotics is SXT-Sulfamethoxazole and AZM-Azithromycin ***TABLE VI.*** The antibiotics sensitivity test for Staphylococcus aureus.

Antibiotic	Resistant	Intermediate	Sensitive	None	Total
AMC	46	1	56	7	110
IPM	0	0	7	103	110
TCC	0	0	4	106	110
CX	38	2	41	29	110
CL	3	1	9	97	110
FEP	12	1	6	91	110
C	3	0	5	102	110
CIP	18	4	73	15	110
SXT	54	2	41	13	110
CTX	9	0	1	100	110
CRO	4	0	3	103	110
AZM	75	0	20	15	110
FA	29	0	64	17	110
AX	40	1	6	63	110
NA	63	5	14	28	110
GN	17	2	73	18	110
AM	36	1	14	59	110
OX	41	0	8	61	110
CAZ	4	0	9	97	110
DO	2	2	19	87	110



The relation between Sex and Doxycycline antibiotic:

As results and in the table investigated sex and Doxycycline antibiotic as shown in the tables (VII&VIII) & figure (VIII). The following tables show the strong significant relationship between sex and Doxycycline antibiotic, where the significant value was 0.002, which is less than 0.05.

ISSN: 2959- 7463

Figure (VII): *The antibiotics sensitivity test for Staphylococcus aureus.*

Table (VII): The relation between sex & Doxycycline include in the study:

The cross tabulation of Sex & Doxycycline		
Sex	**Doxycycline**	
	None	**Sensitive**
Male	11	1
Female	76	18
Total	87	19

Table (VIII): *The relation between sex & Doxycycline antibiotic by Chi-square test*

Chi-Square Tests			
Asymptotic Significance (2-sided)	**df**	**Value**	
0.002	3	14.960[a]	Pearson Chi-Square
a. 5 cells (62.5%) have expected count less than 5. The minimum expected count is .25.			

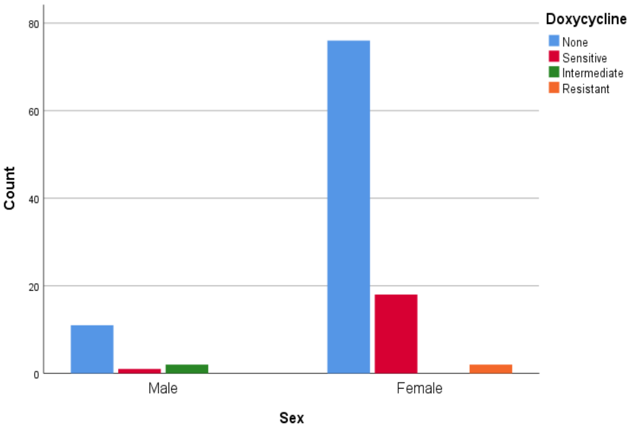


Figure (VIII): *The relation between sex & Doxycycline antibiotic include in the study.*

The relation between Age and Augmentin antibiotic:

As results and in the table investigated age and Augmentin antibiotic as shown in the table (IX) & figure (IX). The following tables show the strong significant relationship between age and Augmentin antibiotic, where the significant value was 0.038, which is less than 0.05.

Table (IX): *The relation between age & Augmentin antibiotic by Chi-square tests*

Chi-Square Tests			
Asymptotic Significance (2-sided)	**Df**	**Value**	
0.038	9	17.735[a]	Pearson Chi-Square
a. 8 cells (50.0%) have expected count less than 5. The minimum expected count is .17.			

ISSN: 2959- 7463

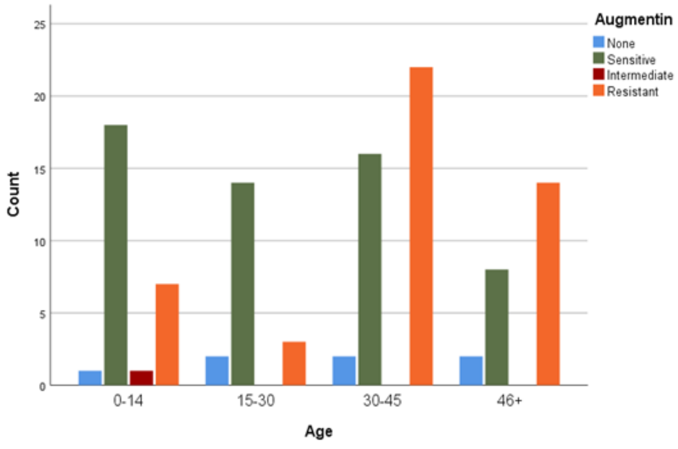


Figure (IX): *The relation between age & Augmentin antibiotic include in the study*

The relation between sex and samples:

As results and in the table investigated sex and samples isolated as shown in the table (X) & figure (X). The table show the significant relationship between sex and samples, where the significant value was 0.05.

Table (X): *The relation between sex & samples by Chi-square tests:*

Chi-Square Tests			
Asymptotic Significance (2-sided)	df	Value	
0.050	3	7.466ª	Pearson Chi-Square
a. 5 cells (62.5%) have expected count less than 5. The minimum expected count is .13.			

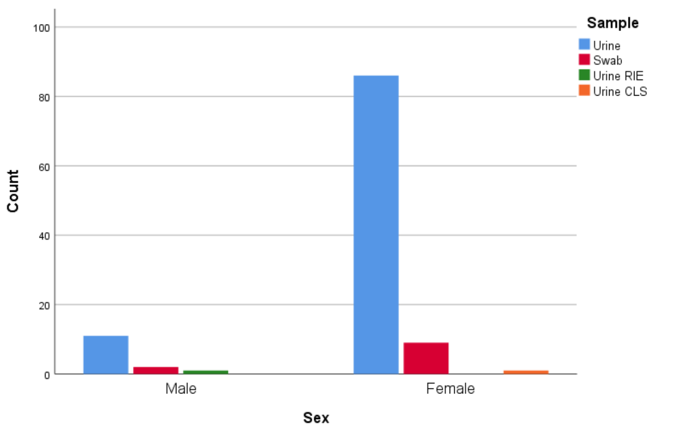


Figure (X): *The relation between sex & samples included in the study*

Staphylococcus aureus is a very common cause of infection in hospitals and is most liable to infect newborn babies, surgical patients, old and malnourished persons and patients with diabetes and other chronic diseases *(*Tuo & Montobbio, *et al*,.1995*).* In this cross-sectional study conducted from January 2022 to April 2022 for about 110 samples which are screened by Disc diffusion method in El Jalaa Hospital for Surgery and Accidents in Benghazi City – Libya. In this study which was made to link the study and compare it with our study was achieved in 2022. In contrast to our study, two studies reported that the isolation of *Staphylococcus aureus* from clinical samples in 2017 was more in male samples than in female where in this study it was 14 (12.7%) were male and 96 (87.3%) were female and antibiotic susceptibility patterns were determined for several acquired *S. aureus* isolates from different clinical isolates. A high percentage (99%) of *S. aureus* strains were obtained from urine and (11%) of the strains were obtained from swabs among clinical isolates, in contrast to our study scored by Mehta and Rajaduraipandi, a high isolation rate of pus and wound swabs in his study while Qureshi from Pakistan recorded a high isolation rate of pus. (Mehta *et al.*,1998, Rajaduraipandi *et al.*,2006, Qureshi *et al.*,2004) .We observed by isolating 110 strains of *S. aureus* documented sensitivity to gentamicin and ciprofloxacin 73 (66.4%). In contrast to our study, the two studies reporting high sensitivity of *S. aureus* to vancomycin 90 (88%). (Mehta *et al.*,1998, Rajaduraipandi *et al.*,2006) The most common drug resistance in *S. aureus* isolates were sulfamethoxazole 54 (49.1%) and azithromycin 75 (68.2). %), in contrast to Qureshi who reported resistance to gentamicin and imipenem. (Rajaduraipandi *et al.*,2006) The high-level resistance could be associated with earlier exposure of these drugs to isolates which may have enhanced development of resistance. There is high level antibiotic abuse in this environment arising from self-medication which is often associated with inadequate dosage and failure to comply to treatment (Odugbemi,1981), and availability of antibiotics to consumers across the counters with or without prescription (Paul, Aderibie, *et al*,.1982). In our study *Staphylococcus aureus* has showed a high resistance to Sulfamethoxazole and Azithromycin which is similar to the study reported by Onwubiko & Sadiq in 2011. It had been observed that the indiscriminate use of antibiotics without prescriptions in the developing countries where there is no. The emergence of antibiotic resistant bacteria constitutes a major problem in antibiotic therapy. This could be attributed to unrestricted use of antibiotics in a particular environment. In our study found a strong significant relationship between sex and Doxycycline antibiotic, where (p. value=0.002) and between age and Augmentin antibiotic, where (p. value =

0.038). this study was recorded a significant relationship between (age & sex) & (sex and samples) where (p. value=0.05).

IV. CONCLUSION

This study highlights the necessity for continuous surveillance of antibiotic sensitivity pattern of *Staphylococcus aureus* with a view to choosing applicable therapy. Certain side effects and limitations are important to consider when choosing antibiotic therapy. This study may be helpful in guiding empiric treatment caused by *S aureus*. Our study is presented to assist epidemiologists to understand the nature of *S. aureus* isolates in this part of Libya

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