ISSN 2664-4169 (Print) & ISSN 2664-7923 (Online)
South Asian Research Journal of Biology and Applied Biosciences
Abbreviated Key Title: South Asian Res J Bio Appl Biosci

| Volume-8 | Issue-1 | Jan-Feb -2026 | **DOI: https://doi.org/10.36346/sarjbab.2026.v08i01.009**

Original Research Article

Epidemiological Distribution and Antibiotic Susceptibility of *Staphylococcus aureus* Isolated from Different Body Sites in Basrah City, Iraq

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Article History
Received: 09.12.2025
Accepted: 07.02.2026
Published: 10.02.2026

Abstract: ***Background*:** *Staphylococcus aureus* is a pathogen that is one of the principal agents of human disease. The clinical importance of the organism is enhanced by an increase in antimicrobial resistance across the globe in which treatment options are compromised both in hospitals and in the community. ***Objective*:** Characterize the epidemiology of methicillin-resistant *S. aureus* (MRSA) and its respective resistance phenotype to the commonly used antibiotics. ***Methodology*:** This is a cross-sectional investigation to be developed between 2023 and 2025 at the Dar Al Shifa Hospital, which will process 388 clinical samples, including sputum, wound exudate, and peripheral blood. Traditional methods of bacterial culture were initially used, and then a conclusive identification and antimicrobial susceptibility screening was performed using an automated VITEK 2 instrumentation as per CLSI guidelines. ***Results*:** Among 272 cultures exhibiting growth, 80 were identified to be *S. aureus* (29.41% of positive cultures). The sources of skin and soft-tissues were most commonly represented (40.31 ⁻), wound sites (50 ∵ of isolates). The highest rate of infection was observed in the age group of 21 to 40 years (31.25 30 -40) (31.25 30 -40). Both benzylpenicillin and erythromycin resistance was significantly high at 91.3 and 62.5 percent respectively with a 47.5 percent prevalence rate of MRSA. Notably, the isolates were all sensitive to vancomycin and tigecycline. ***Conclusion*:** The results highlight the presence of a significant MRSA burden in Basrah that should be immediately changed by updating empirical antimicrobial regimens.

Keywords: *Staphylococcus aureus,* Antibiotic Resistance, MRSA.

INTRODUCTION

Staphylococcus aureus is a highly adaptable human pathogen, causing mild and invasive infections (SSTIs), in addition threatening diseases, including endocarditis, osteomyelitis, and sepsis (Locke *et al*., 2025). A combination of its capability to colonize the skin and nares of healthy people and a wide range of virulence factors, poses a lasting threat both in the community and healthcare (Wang *et al*., 2025). *S. aureus* infections have a significant burden in the world, and their treatment is often complicated due to prevalent increase of antimicrobial resistance (AMR) (Gehrke *et al*., 2023).

The most important issue with dealing with *S. aureus* infections is that Methicillin-Resistant *S. aureus* (MRSA) is a bacterium that is immune to all beta-lactam antibiotics (Sami and Qassim, 2022). MRSA has become a significant nosocomial pathogen but has since become a common disease that appears in the community, which includes healthcare-associated (HA-MRSA) and community-associated (CA-MRSA) infections (Lin *et al*., 2023). MRSA occurs in different geographic areas with a variety of reports showing high and alarming amounts in the Middle East, such as Iraq (Al-Fahad and Al-Dulaimi, 2024; Qader and Al-Khafaji, 2025). One of the possible causes of such high prevalence is the use of antibiotics that are not regulated, as well as insufficient infection control measures (Hashim and Al-Khafaji, 2024).

Citation: Iltefat Amer Al-Tameemi & Samiya Shamkhi Jebur (2026). Epidemiological Distribution and Antibiotic Susceptibility of *Staphylococcus aureus* Isolated from Different Body Sites in Basrah City, Iraq. *South Asian Res J Bio Appl Biosci, 8*(1), 64-69.

Early and correct diagnosis of *S. aureus* and identification of its susceptibility pattern are the key to the proper management of the patient. Current clinical microbiology testing centers are based on automated methods, including the VITEK 2 Compact System that delivers quick and dependable outcomes with regard to bacterial identification as well as antimicrobial susceptibility testing (AST) (Their *et al*., 2024; Mshari, and Alrudainy, b2026). VITEK 2 system is a precious tool in surveillance and clinical decision making due to its high accuracy in the detection of resistance mechanisms including oxacillin resistance (Filippin *et al*., 2014). The aim of the study was to identify the epidemiology of *S. aureus* in various clinical sites and age groups in Basrah City, Iraq, and to globally assess the antimicrobial resistance of the isolates with special consideration to the MRSA prevalence.

Materials and Methods

Study Design and Samples Collection

This is a cross-sectional study that was carried out at Dar Al Shifa Investment Hospital, Basrah city, Iraq, between October 2023 and January 2025. There were 388 clinical samples that were gathered on patients who had suspected infections by bacteria. The samples were sputum, throat, nasal swabs, skin swabs, wound swabs, pus, abscess aspirates, and blood samples. All the specimens were gathered in aseptic conditions according to the standard infection control practices and immediately taken to the microbiology laboratory to be processed.

Bacterial Culture and Isolation

Non-blood samples were inoculated onto Blood Agar and MacConkey Agar plates and left to incubate aerobically at 37 o C 18 24 hours. Automated blood culture system was used to process blood samples, and on positive cultures, a subculture was done on Blood Agar media and MacConkey Agar media. The isolates of Presumptive *Staphylococcus aureus* were chosen according to morphology of the colonies, hemolysis, and Gram staining.

Identification of Isolates

Biomarker Preliminary diagnosis was done through traditional biochemical tests catalase and coagulase tests. The VITEK 2 Compact System (bioMerieux, France) was used to identify it up to final according to the instructions of the manufacturer. Bacterial cultures were formulated into 0.5 McFarland standard before being loaded to the identification cards.

The Testing of Antimicrobial Susceptibility

All the confirmed *Staphylococcus aureus* isolates (n=80) were tested with the VITEK 2 Compact System on AST cards. The antibiotic panel consisted of 18 antimicrobial agents of various therapeutic categories. The interpretation of the susceptibility results was done as per Clinical and Laboratory Standards Institute (CLSI) guidelines. The resistance profiles on cefoxitin and oxacillin were used to identify Methicillin-resistant *Staphylococcus aureus* (MRSA).

Statistical Analysis

Statistical software was applied to analyze data. Descriptive analysis was done by using frequencies and percentages. Associations among categorical variables were assessed using Pearson Chi-square test whose p-value was taken to be less than 0.05.

Results and Discussion

There were 388 clinical samples that were processed, and 272 (70.1%) positive bacterial cultures were obtained. Out of these positive cultures, 80 isolates (29.41%) were classified as *S. aureus*. Included skin and soft tissue infections (SSTIs), which is the principal source, 61 (40.31 %) of the isolation of *S. aureus*. In this category the highest specific isolation rate was 50% in the Wound samples. Conversely, respiratory tract gave 17 isolates (14.91%), and blood cultures gave 2 isolates (33.33 %) of positive growths (Table 1).

Table 1: Distribution of clinical samples, bacterial growth, and *Staphylococcus aureus* isolates

Type of samples		No. Samples	Positive growth	Negative growth	*Staphylococcus aureus* N0.(%)
Respiratory tract	Sputum	134	90	44	12 (13.33)
	Throat swab	27	16	11	3 (18.75)
	Nasal swab	15	8	7	2 (25)
	Total	176	114	62	17 (14.91)
Skin and soft tissue	Skin swab	121	100	21	38 (38)
	Wound	16	14	2	7 (50)
	Pus	14	13	1	6 (46.15)
	Abscess	28	25	3	10 (40)
	Total	179	152	27	61 (40.31)

Type of samples		No. Samples	Positive growth	Negative growth	*Staphylococcus aureus* N0.(%)
Blood	blood culture	33	6	27	2 (33.33)
Total	—	388	272	116	80 (29.41)

Pearson Chi-Square= 37.50, df= 7, p-value= 0.001

The prevalence of *S. aureus* in Skin and Soft Tissue Infections (40.31%) in Basrah is in line with the global epidemiological patterns that define the pathogen as the most common cause of pyogenic skin infections (Malohifo'ou, 2022). The rate of isolation due to Wounds (50%) and Pus (46.15 %) is high and it indicates that there is a great burden of the community-acquired and healthcare-associated infections in the area. This distribution is in agreement with other researchers who have found that *S. aureus* is the most common isolate in Iraqi invasive surgery site infections (Sami and Qassim, 2022).

The prevalence of *S. aureus* in skin and soft tissue infections is due to its natural colonization of the skin and of the nose mucosa and capability to induce infections after the barrier has been breached (Lin *et al*., 2023). The high rescue rates of wound and pus samples are caused by its virulence features, toxins production, and biofilm formation that promote wound tissue persistence (Wang *et al*., 2025).

(Figure 1) showed that *S. aureus* was distributed differently in various body sites among the groups of ages that were studied in Dar Al Shifa investment Hospital/Basrah City/Iraq. The maximum isolation rates of skin and soft tissue samples were in the 21-40-year age group (31.25%), then, in the 41-60-year age group (22.50%), >60 years (12.50 percent), and 0-20 years (10.00 percent). In the respiratory tract, comparatively low prevalence rates were observed regardless of the age group with the highest being 21-40-year (7.50 %) and 41-60-year (6.25 %). Blood samples showed a small recovery of *S. aureus*; 1.25% in 21-40- and 41-60-year groups, but none in 0- 20 and greater groups. The chi-square test conducted by Pearson showed that the differences in the distribution of *S. aureus* between age groups and types of samples were statistically significant.

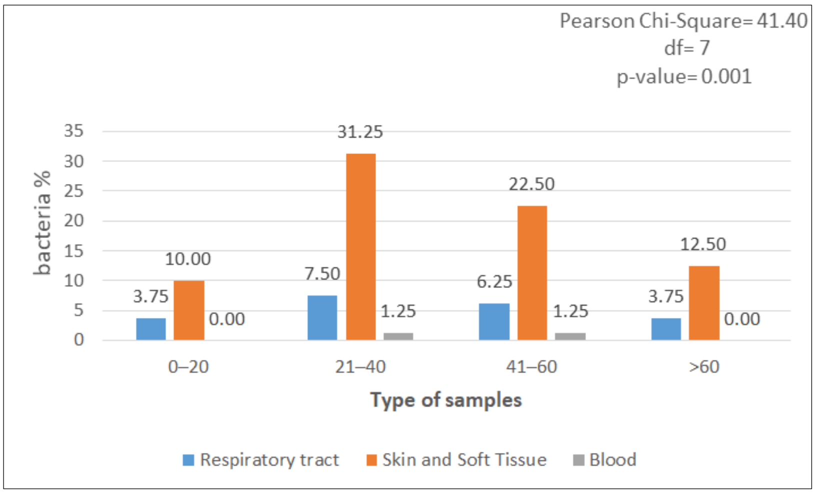

Fig. 1: *Staphylococcus aureus* Distribution by Age Groups

The age distribution of 21-40-year-olds and older is consistent with the existing literature that mentions that active adults are more prone to skin colonization because they encounter occupational agents, socialization, and more likely to suffer minor traumas that undermine the integrity of the skin (Gehrke *et al*., 2023). The reduced frequency of *S. aureus* in respiratory tract samples of all ages is consistent with previous findings of lower colonization rates of respiratory versus skin in most individuals, except in individuals with underlying pulmonary conditions (González-García *et al*., 2021). The low blood isolation makes it possible to conclude that *S. aureus* bacteremia is not that common in the general population, yet its potential severity is high (Thari *et al*., 2024). The age-specific distribution pattern as found here is also consistent with the patterns in the world, with young adults having a higher number of skin and soft tissue infections, but the older adults show a progressive decline, which may be because of less exposure and variation in the immunogenicity (Rasquel-Oliveira *et al*., 2025). It is important to note that statistical significance of the study findings in our case supports the applicability of age and anatomical site to epidemiology of *S. aureus* that is essential in designing specific infection control efforts.

S. aureus distribution in clinical samples, which was different in relation to the type of sample and sex of patients (Figure 2). The most prevalence among the males was found in skin and soft tissue infections (40%), respiratory samples

(12.2%), and blood (1.25%). In the same way, the females recorded the highest prevalence in skin and soft tissue infections (36.25%), respiratory samples (8.75%), and blood samples (1.25%). The statistical analysis, which indicates that the distribution of *S. aureus* infections might vary between males and females based on the anatomic location.

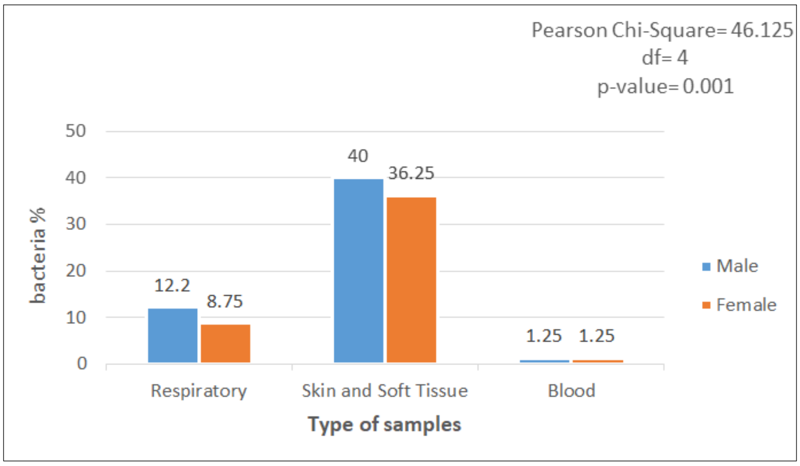

Fig. 2: *Staphylococcus aureus* Distribution by sex

The global trend with *S. aureus* prevalence in skin and soft tissue infections supports the idea that this pathogen is among the key causes of dermatological infections (Costa *et al*., 2022). The identified increased prevalence in males (40%) than females (36.25%), could be due to occupational exposure, skin colonization, or health-seeking behavior, which was proposed earlier in Iraq (Al-tameemi, 2024). This is in line with the opportunistic nature of *S. aureus* that is usually acquired by the nares and the skin without affecting the lower respiratory tract unless there are predisposing conditions (González-García *et al*., 2021).

Interestingly, that the overall isolation of *S. aureus* of blood (1.25% in each sex) is minimal supports the previous research that bloodstream-related infections, despite their high severity, are less common in the community than skin or respiratory colonization (Mshari and Alrudainy, a2026). The effective Chi-Square value also emphasizes that one should always take sex-related differences into account during epidemiological monitoring and control measures of infections.

The resistances of the *S. aureus* isolate (n=80) to the traditional beta-lactam antibiotics were intense. Benzylpenicillin was the most resistant (91.3 percent) then Erythromycin (62.5 percent). In the identification of Methicillin-resistant *S. aureus* (MRSA), Cefoxitin screen and Oxacillin resistance were noted at 47.5 percent and 46.3 percent, respectively. The resistance to fluoroquinolone was observed to be moderate, and Levofloxacin (43.8%), and Moxifloxacin (41.3%) showed similar patterns. Aminoglycosides had a high resistance especially in case of Gentamicin (42.5 percent) and Tobramycin (41.3 percent). The isolates on the other hand were very susceptible to last-resort glycopeptides and oxazolidinones; Vancomycin and Tigecycline were found to have zero resistance, whereas Linezolid (1.3 percn) and Teicoplanin (2.5 percn) had no resistance level. A Pearson Chi-Square test was used to ensure that the difference in resistance between the various classes of antibiotics was statistically significant. (Figure 3).

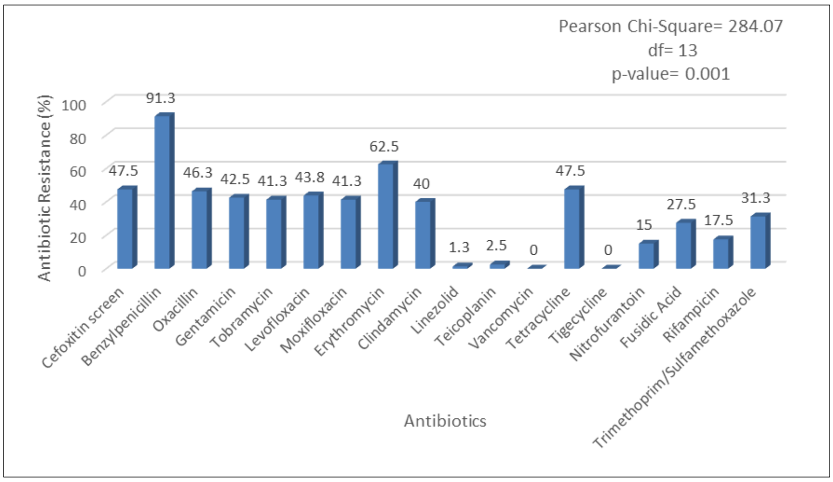

Fig. 3: Antibiotic resistance for *Staphylococcus aureus,* isolated from different site infections

The antimicrobial resistance (AMR) levels were high in this study, which is alarming in the clinical setting in Basrah. The observed near-total resistance to Benzylpenicillin (91.3%) is in line with investigation in Basrah, whereby production of beta-lactamase in *S. aureus* has become almost universal (Mshari, and Alrudainy, a2026). Of greater concern is the MRSA rate which is shown by resistant to Cefoxitin (47.5%). This is in line with recent reports by neighboring areas in Iraq and prevalence of MRSA is usually between 40 and 55 percent because antibiotics are sold over the counter and no intense prescription controls are practiced (Chandra *et al*., 2021). High resistance to Erythromycin that is 62.5% indicates the prevalence of the erm genes, which in many cases mediate cross-resistance against other macrolides (Miklasińska-Majdanik, 2021). This is significantly greater than the rates that are reported in European surveillance data, but it is equal to the results of other developing healthcare systems where macrolides are usually used in the treatment of respiratory and skin infections (Bashabsheh *et al*., 2024). Interestingly, Vancomycin (0) and Tigecycline (0) were absolutely susceptible to the isolates. This implies that the problem of multi-drug resistance (MDR) is a common one but the vancomycin-resistant *S. aureus* (VRSA) strain does not yet have a foothold in Basrah. This is similar to the results of a meta-analysis by Shariati *et al*., (2020), who found that although Vancomycin-intermediate *S. aureus* (VISA) is becoming a worldwide issue, VRSA (true) is not common in clinical isolates of the Eastern Mediterranean region.

The statistically significant underlines the fact that resistance is not even but is highly concentrated towards older and more accessible classes of antibiotics. This gap illustrates necessity to implement local antimicrobial stewardship programs to maintain the effectiveness of the remaining treatment options such as Linezolid and Nitrofurantoin which has a comparatively low resistance rate (15%), which can be used as a candidate treatment against localized skin and soft tissue infections (SSTI) or uncomplicated urinary tract infections related to *S. aureus*.

CONCLUSION

This study proves the high occurrence of *S. aureus* in SSTIs in Basrah, Iraq and indicates an alarming rate of MRSA 47.5 percn. Such resistance to traditional beta-lactam, macrolides, and fluoroquinolones is so high that it requires an immediate change in the empirical therapy regimens. The persistent susceptibility to Vancomycin, Tigecycline and Linezolid offers a small, yet critical, window of therapy. To continue the efficacy of these last-resort antibiotics and prevent the spread of the MRSA, close attention to antimicrobials and continuous monitoring should be observed.

Ethical Approval

The study was conducted in accordance with the approval issued by the Research Ethics Committee of the Basra Health Directorate, pursuant to Protocol No. 115 dated October 3, 2024. Informed verbal consent was obtained from all patients prior to the study's commencement.

Conflict of Interest: Both authors acknowledge that the article contains no conflicts of interest.

Funding: None

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