

The Prevalence of Multidrug-resistant *Staphylococcus aureus* Isolated from Different Clinical Samples

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Abstract

Background: Antibiotic resistance is a major global issue, with *Staphylococcus aureus* being one of the most common resistant bacterial forms. **Objective:** The study's goal was to determine the prevalence of multidrug-resistant (MDR) *S. aureus* isolated from clinical specimens. **Materials and Methods:** The standard microbiological techniques used for isolates identification were subsequently validated by the VITEK-2 system. Antibiotic susceptibility was assessed using the disc diffusion technique. MDR bacteria were those that were resistant to three or more antibiotics. **Results:** *S. aureus* prevalence in clinical isolates was 27.9%. There was significant resistance toward all antibiotics used in the study except for tetracycline. About 98.2% of the isolates were MDR. **Conclusion:** Our results underscore the need for continued antibiotic resistance monitoring in *S. aureus* isolates associated with hospital-acquired infections.

Keyword: Antibiotic susceptibility, multidrug resistance, *Staphylococcus aureus*

INTRODUCTION

For more than a century, *Staphylococcus aureus* (*S. aureus*) has been recognized as a concern for human health. This bacterium causes many illnesses from folliculitis and food poisoning to life-threatening diseases such as endocarditis and necrotizing pneumonia^[1] because of its virulence, which enables it to surface adhere, infiltrate, or escape the immune system and causes severe toxicity in the host.^[2] Despite ongoing advances in the diagnostic and medical sciences, it is harbored by 20–30% of the population without manifesting clinically. The bacteria can adapt to a variety of environments, and a single positive isolate might turn into an epidemic or even a pandemic clone with high mortality and morbidity.^[3] Antimicrobial resistance is a growing problem that threatens public health. It occurs because microbes have evolved the ability to drub antimicrobial substances designed to kill them. The issue originates from the fast spread of antibiotic resistance over the world; as a result, various international health organizations have designated it as a global risk.^[4] The emergence of multidrug-resistant (MDR) strains has made treating *S. aureus* infections more difficult, creating a serious concern for healthcare staff worldwide. MRSA (methicillin-resistant *S. aureus*)

resists nearly all beta-lactam antibiotics, which increases its pathogenicity or allows it to cause certain clinical symptoms.^[5] Resistance to vancomycin, which is utilized in the treatment of Gram-positive bacteria, including *S. aureus*, as an alternate to beta-lactam antibiotics, is a concern for public health.^[6] The number of fatalities owing to antimicrobial resistance will reach 10 million per year by 2050, resulting in a 100 trillion \$ economic loss. If nothing is done, many important diseases will be difficult to cure in the future because of this resistance.^[7] Our research aimed to assess the prevalence of MDR *S. aureus* isolates in order to determine their significance in future research.

MATERIALS AND METHODS

From September 2021 to March 2022, a total of 203 clinical specimens (129 males and 74 females, ages 18–85 years) which include sputum, urine, foot ulcer, nasal, and wound

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swabs were obtained from Azadi Teaching Hospital and the public health laboratory in Kirkuk, Iraq. The specimens were inoculated on blood agar right away. After Gram staining, the colonies that suspected to be *S. aureus* were cultivated on mannitol salt agar for 24 h and incubated at 37°C. Then, it was detected according to the characteristics of the colony on this agar. The findings were subsequently verified using biochemical tests (catalase and coagulase)^[8] and confirmed by the VITEK-2 Compact system. By disc diffusion method, as the Clinical Laboratory Standard Institute (CLSI) suggests, all isolates were screened for antibiotic susceptibility.^[9] The turbidity of the nutritious broth suspension was measured by the McFarland 0.5 standard and dispersed equally over the Mueller–Hinton agar surface by a cotton swab. Following that, oxacillin (1 µg/mL), tetracycline (30 µg/mL), cefoxitin (30 µg/mL), vancomycin (30 µg/mL), rifampicin (5 µg/mL), clindamycin (10 µg/mL), chloramphenicol (10 µg/mL), imipenem (10 µg/mL), linezolid (30 µg/mL), and levofloxacin (5 µg/mL) antibiotic discs were put on the agar and then incubated overnight at 37°C. The diameter of zone inhibition was used to categorize the isolates as resistant, intermediate, or susceptible. Bacteria that were resistant to three or more class of antibiotics were designated as MDR.^[10]

Statistical analysis

In this study, data are supplied as a number and a percentage, whereas χ^2 is used to assess it. Using the Statistical Package for Social Sciences (SPSS) ver. 25 (2017),^[11] the *P*-value of 0.05 is regarded as significant, whereas the *P*-value of 0.01 was highly statistically significant.

Ethical approval

This study was carried out in conformity with the ethical standards outlined in the Helsinki Declaration. Before taking the specimen, verbal and analytical consents of the patients were obtained. To obtain this permission, a local Ethics Committee examined and approved the study protocol, subject information, and consent form using the document number (42482 in 9/12/2021).

RESULTS

By using culture, macroscopic and microscopic examination was confirmed by the VITEK-2 system. We obtained 56 (27.5%) *S. aureus* isolates. The disc diffusion technique was used to assess antibiotic susceptibility in these isolates, as recommended by the CLSI.^[9] They show to have a high level of resistance toward the antibiotics that were utilized in this study, as listed in Table 1.

The isolates were sorted to get a resistance pattern, which was crucial for identifying their infectivity behavior. As a result, the findings in Figure 1 demonstrate that 56 *S. aureus* isolates (98.2%) showed multidrug resistance to the antibiotics used

Table 1: Percentages of antibiotic susceptibility in *S. aureus* isolates

Antibiotics	Sensitive	Resistance	<i>P</i> -value
Oxacillin	0 (0%)	56 (100%)	0.001*
Cefoxitin	38 (67.9%)	18 (32.1)	0.000*
Chloramphenicol	14 (25%)	42 (75%)	0.000*
Levofloxacin	12 (21.4%)	44 (78.6%)	0.000*
Linezolid	14 (25%)	42 (75%)	0.000*
Imipenem	56 (100%)	0 (0%)	0.000*
Rifampicin	56 (100%)	0 (0%)	0.000*
Clindamycin	18 (32.1%)	38 (67.9%)	0.000*
Tetracycline	23 (41.1%)	33 (58.9%)	0.58 ⁿ

n: non-significant, *significant

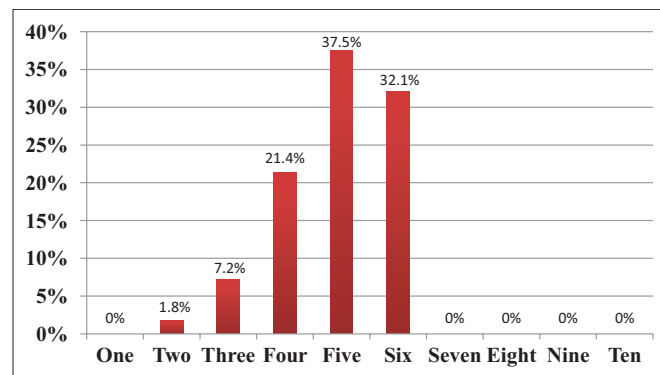


Figure 1: Multidrug resistance pattern of *S. aureus* isolates

Table 2: Number and percentage of the MRSA and MSSA isolates

MRSA	MSSA	Total no. of isolates
18 (32.1%)	38 (67.9%)	56 (100%)

in this investigation. The data indicated that 18 (32.1%) isolates had the highest MDR to antibiotics (resistant to six antibiotics). Although just four isolates showed the lowest MDR (representing 7.2%), they were resistant to only three antibiotics. The highest proportion was seen in the group that resisted five antibiotics; 21 isolates constituted 37.5% of the isolates in this group.

Also the results showed that 18 isolates were MRSA as they were resistant to oxacillin and cefoxitin disc according to the CLSI, as in Table 2.

DISCUSSION

S. aureus (an opportunistic human bacterium) causes a wide spectrum of clinical community and nosocomial infections. The emergence of MDR strains is mostly attributed to the increase in infections by this bacterium.^[12] The results revealed 27.9% of *S. aureus* isolates, which are close to the findings of the study^[13] that were obtained (29.55%). This predominance might be related to the fact that it is a

common commensal bacterium of mucosa and skin, which is one of the primary sources of infection in humans.^[14] The isolates showed significant resistance to all antibiotics used in the study except for tetracycline, which was not statistically significant. Because of the high resistance of the isolates to linezolid, levofloxacin, and chloramphenicol in the current study, these antibacterial drugs should be demonstrated to be ineffective in eradicating *S. aureus* infections. More than half of the isolates have also shown resistance to clindamycin and tetracycline, meaning that additional isolates may become resistant in the near future and that antimicrobial therapy for illnesses caused by such staphylococcal strains would be restricted. Resistance among local bacterial isolates is increasing as a result of random antibiotic misuse and the eating of contaminated meat.^[15] The MDR pattern of the isolates matched that of the study,^[16] which discovered that 98.67% of *S. aureus* isolates from clinical samples in Baghdad were MDR. Despite the fact that it is consistent with numerous studies in Iraq^[17,18] and elsewhere, the MDR of *S. aureus* observed in this study is quite worrying.^[19] As those studies show, the virulence of this pathogen has caused widespread bacterial resistance.^[20] Most isolates were resistant to more than three antibiotics. This means that they did not respond to them. This might be due to its overuse in the environment and clinical settings, which is leading to the emergence of MDR bacterial diseases. With raised expression levels of MDR genes, including those encoding aminoglycoside, beta-lactam, and other types,^[16] this has become a worldwide problem.^[21] MDR varies among isolates, which might be related to a number of factors, including the origin of an isolate, ability to withstand antibiotic effects, and antibiotic concentration variations.^[22] Antibiotic resistance is associated with increased hospitalization, death, and treatment costs, including the need for alternative therapies.

CONCLUSION

The majority of isolates were MDR. Our data underscore the need of continued antibiotic resistance monitoring in *S. aureus* isolates associated with infections that are acquired from hospitals.

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Conflicts of interest

There are no conflicts of interest.

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