www.ijarp.com ISSN 2456-9992 Page: 01-08

International Journal Advanced Research Publications

Review Article

Volume: 02
Issue: 07

INCIDENCE AND ANTIMICROBIAL SUSCEPTIBILITY PATTERN OF METHICILLIN-RESISTANT STAPHYLOCOCCUS AUREUS (MRSA) IN HEALTHCARE WORKERS: A REVIEW

Rupinder Saini*[1], Dr Rajender Kumar[2], Dr Manita Paneri[3], Sachin Chawla[3]

[1]*M.Sc. (Clinical Microbiology), Faculty of Health and Allied Sciences, Guru Kashi University.*

[2]*Dean, Faculty of Allied and Healthcare, Guru Kashi University.*

[3]*Assistant Professor, Faculty of Allied and Healthcare, Guru Kashi University.*

Article Received: 19 June 2026, Article Revised: 09 July 2026, Published on: 29 July 2026

***Corresponding Author: Rupinder Saini**

M.Sc. (Clinical Microbiology), Faculty of Health and Allied Sciences, Guru Kashi University.

Doi: https://doi-doi.org/101555/ijarp.9915

ABSTRACT

Staphylococcus aureus is a major human pathogen responsible for infections ranging from superficial skin and soft-tissue disease to life-threatening bacteremia, endocarditis and pneumonia, and the emergence of methicillin-resistant strains (MRSA) has substantially complicated its clinical management. Healthcare workers (HCWs), owing to frequent and close patient contact, can act as reservoirs and vectors for MRSA transmission within hospitals. This review synthesises the literature on MRSA epidemiology and antimicrobial resistance alongside a prospective study conducted at Fortis Hospital Mohali, Punjab, in which 70 clinical samples from healthcare workers were processed by culture, Gram staining, biochemical testing and Kirby–Bauer disc-diffusion antimicrobial susceptibility testing (AST). Wound swabs were the most frequent sample type, and isolates were predominantly obtained from workers in the 61–70 year age range. AST revealed that S. aureus isolates were most consistently susceptible to vancomycin, clindamycin and trimethoprim-sulfamethoxazole, while resistance was highest to linezolid, teicoplanin and oxacillin — a pattern indicating a substantial MRSA and multidrug-resistant burden in this cohort. These findings reinforce the importance of routine surveillance, antimicrobial stewardship, and strict infection prevention and control practices among healthcare personnel.

KEYWORDS: *Staphylococcus aureus, MRSA, MSSA, antibiotic susceptibility, healthcare workers, infection control*

1. INTRODUCTION

Staphylococcus aureus is a gram-positive bacterium capable of causing a wide spectrum of disease, from minor skin infections to sepsis and infective endocarditis. The emergence of methicillin-resistant S. aureus (MRSA) strains, which are frequently resistant to multiple antibiotic classes, has made treatment considerably more difficult and has driven an urgent need for improved antimicrobial agents and infection control measures. Historically, S. aureus developed resistance to penicillin within one to two years of its clinical introduction, to methicillin within less than a decade, and to vancomycin only after roughly forty years — a trajectory that illustrates the pathogen's remarkable adaptive capacity.

Healthcare workers occupy a central position in MRSA transmission dynamics. Because of their close and repeated contact with patients, they may become colonised and act — often unknowingly — as vectors that spread the organism within healthcare facilities. Reported colonisation rates among HCWs vary considerably across hospital settings, departments and countries, reflecting differences in local hygiene practices and infection control adherence, and underscoring the value of regular surveillance. Antimicrobial susceptibility testing (AST) remains an essential clinical tool, guiding empirical antibiotic choice and informing broader infection control and stewardship strategies, while patient- and worker-level factors such as age, comorbidity and prior antibiotic exposure further shape treatment success.

Global data illustrate the scale of the problem: severe MRSA infections numbered around 100,000 in the United States in 2005 alone, with associated deaths (approximately 19,000) exceeding those attributed to HIV/AIDS in the same year, and MRSA bacteremia rates rose sharply across multiple regions — including Quebec, Oxfordshire, Minnesota and Calgary — between the late 1990s and mid-2000s, driven substantially by epidemic clones such as USA300 in North America and EMRSA-15/16 in the United Kingdom. Encouragingly, improved infection control practices have since driven notable declines in MRSA bacteremia in several of these same regions.

1.1 Aim and Objectives

The study's aim was to assess the antibiotic susceptibility of MRSA isolates among healthcare workers. The specific objectives were: (1) to analyse the distribution of infection sites associated with S. aureus in the studied population; (2) to determine the antimicrobial susceptibility pattern of S. aureus isolates in a tertiary care hospital; and (3) to contribute to ongoing surveillance of antimicrobial resistance and inform infection control measures.

2. Review of Literature

MRSA is consistently reported to be more prevalent in hospital than community settings, with clinical isolates showing high resistance rates to penicillin and macrolides. Recognised risk factors for S. aureus infection and resistance include prior antibiotic exposure, hospitalisation, diabetes and immunosuppression. In one series of 160 clinical isolates, overall antimicrobial susceptibility was 100% for vancomycin but fell markedly for other agents — 49.4% for amikacin, 43.8% for gentamicin, 36.8% for co-trimoxazole and tetracycline, and as low as 3.1% for penicillin — identifying vancomycin, amikacin and gentamicin as the most reliable agents against S. aureus, and penicillin, oxacillin and erythromycin as the least reliable.

Indian data reflect a similarly concerning picture. A study of clinical specimens in Amritsar (2008–2009) reported an MRSA prevalence of 46%, while a neonatal intensive care unit study in the same city found an MRSA rate of 57.3% among blood culture isolates. In Odisha, 60% of nosocomial

S. aureus isolates were resistant to oxacillin and cefoxitin, with two isolates additionally harbouring the mecA, cfr and vanA resistance determinants — conferring resistance to methicillin, linezolid and vancomycin simultaneously. In eastern Uttar Pradesh, 54.8% of isolates were identified as MRSA, with more than 80% resistant to penicillin, co-trimoxazole, ciprofloxacin, gentamicin, erythromycin and tetracycline. A broader multi-year Indian dataset (2018–2019) reported an MRSA prevalence of 37.5% among 576 samples, concentrated particularly among ICU and infectious-disease ward patients, with close to half of isolates classified as multidrug-resistant while remaining almost universally susceptible to daptomycin, linezolid, tigecycline and vancomycin — a pattern that contrasts with the higher linezolid resistance observed in the present study population.

3. MATERIALS AND METHODS

The study was conducted at Fortis Hospital, Mohali, Punjab, from January to June 2026, on a purposively sampled population of healthcare workers — doctors, nursing staff, laboratory professionals and general duty assistants (GDAs). A total of 70 clinical samples were collected, comprising blood, wound swab/pus, urine, sputum, tissue, tracheal secretion, and other sterile body fluids such as bronchoalveolar lavage (BAL).

Each sample type followed a dedicated collection and processing protocol under aseptic conditions: blood was cultured in BACTEC 40X/200X automated systems before subculture on blood and MacConkey agar; wound/pus samples were plated directly onto blood and

MacConkey agar; urine was inoculated onto CLED agar following midstream clean-catch collection; and sputum and other body fluids were processed on blood, chocolate and MacConkey agar (the latter omitted for bile fluid), with fluids centrifuged prior to slide preparation. All plates were incubated at 37°C for 24–48 hours. Gram staining was used for preliminary morphological and staining-pattern identification, followed by catalase and oxidase biochemical tests to confirm Staphylococcus aureus (catalase-positive, oxidase-negative).

Antimicrobial susceptibility testing was performed using the Kirby–Bauer disc diffusion method on Mueller–Hinton agar. A 0.5 McFarland-standardised bacterial suspension was swabbed as a lawn culture, antibiotic discs — vancomycin, teicoplanin, clindamycin, oxacillin and trimethoprim-sulfamethoxazole, along with linezolid — were applied at standard spacing, and plates were incubated at 37°C for 24 hours before the zone of inhibition around each disc was measured and interpreted as sensitive, intermediate or resistant. Selected multidrug-resistant isolates were additionally tested for antibiotic synergy using ceftazidime-avibactam and aztreonam combinations. Positive AST results were reported to the hospital's infection control cell to guide targeted surveillance and containment measures.

4. RESULTS

Of the 70 samples processed, wound swabs were the most frequent source (24 samples, 34.28%), followed by pus (15, 21.42%), tissue (10, 14.28%), blood (6, 8.57%), urine and tracheal secretion (5 each, 7.14%), BAL (3, 4.28%) and sputum (2, 2.85%). The study population was predominantly male (50, 71.42%) compared with female (20, 28.57%).

Table 1. Distribution of S. aureus isolates by clinical sample type.

Sample Type (N=70)	Frequency	Percentage
Wound swab	24	34.28%
Pus	15	21.42%
Tissue	10	14.28%
Blood	6	8.57%
Urine	5	7.14%
Tracheal secretion	5	7.14%
BAL	3	4.28%
Sputum	2	2.85%

Table 2. Age distribution of S. aureus isolates, showing a peak in the 61–70 year age group.

Age Group (years)	Frequency	Percentage
10–20	6	8.57%
21–30	4	5.71%
31–40	6	8.57%
41–50	7	10.00%
51–60	11	15.71%
61–70	22	31.42%
71–80	9	12.85%
81–90	4	5.71%
>90	1	1.42%

Table 3. Antimicrobial susceptibility pattern of S. aureus isolates (out of 70) by Kirby–Bauer disc diffusion.

Antibiotic	Sensitive	Resistant	Intermediate
Vancomycin	53	17	0
Clindamycin	41	25	4
Trimethoprim-sulfamethoxazole	40	28	2
Oxacillin	21	49	0
Teicoplanin	20	50	0
Linezolid	2	68	0

Vancomycin was the most reliably effective agent (76% sensitive), followed by clindamycin (59%) and trimethoprim-sulfamethoxazole (57%), while linezolid showed the highest resistance (97%), followed by teicoplanin (71%) and oxacillin (70%) — the latter indicating a substantial proportion of methicillin-resistant isolates within the cohort.

5. DISCUSSION

The high frequency of MRSA among clinical isolates in this cohort mirrors patterns reported across Indian tertiary care settings, where MRSA prevalence has ranged from roughly 37% to over 60% depending on region and patient population. Because MRSA strains resist multiple antibiotic classes, clinicians are frequently limited to reserve agents such as vancomycin, clindamycin or linezolid, and the observed dominance of oxacillin resistance in this study is consistent with that broader pattern of methicillin resistance.

Notably, this study identified unusually high resistance to linezolid and teicoplanin relative to earlier literature, in which these agents — along with vancomycin — have generally remained close to fully effective. This divergence suggests the possible emergence or local establishment of newer resistance mechanisms in this healthcare worker population, and echoes documented cases elsewhere in India in which S. aureus isolates carried genetic

determinants for methicillin, linezolid and vancomycin resistance simultaneously. Such findings reinforce the dynamic, evolving nature of antimicrobial resistance and the need for continual local surveillance rather than reliance on historical resistance patterns.

The concentration of positive isolates among wound swabs and pus samples, together with the peak incidence in the 61–70 year age group, points toward accumulated occupational exposure and possibly age-related susceptibility among healthcare workers handling wound care and surgical assistance duties. As with any single-centre study, the comparatively modest sample size and restriction to one hospital limit the generalisability of these findings, and broader multi-centre studies across varied healthcare settings and demographics are needed to confirm these resistance trends.

6. CONCLUSION AND RECOMMENDATIONS

This review confirms a substantial burden of MRSA and multidrug-resistant S. aureus among healthcare workers in a tertiary care setting, with resistance most pronounced against linezolid, teicoplanin and oxacillin, and preserved susceptibility to vancomycin, clindamycin and trimethoprim-sulfamethoxazole. These findings, considered alongside the wider Indian and international literature, underscore those isolates as a persistent and evolving threat within the healthcare environment, with meaningful implications for empirical therapy and infection control practice.

Priority recommendations arising from this work include strengthening infection control protocols comprehensive hand hygiene, isolation precautions and environmental cleaning — supported by regular staff training; establishing and reinforcing antimicrobial stewardship programmes that guide appropriate antibiotic selection, dosing and duration; and maintaining continuous local surveillance so that empirical treatment protocols can be adjusted promptly as resistance patterns evolve. Restricting transmission through consistent isolation practices and maintaining sterile hospital environments and equipment remain essential to reducing the risk of MRSA acquisition and spread among both patients and healthcare personnel.

REFERENCES

1. Lowy FD. Staphylococcus aureus infections. N Engl J Med. 1998;339(8):520–532.
2. Hardy KJ, Hawkey PM, Gao F, Oppenheim BA. Methicillin resistant Staphylococcus aureus in the critically ill. Br J Anaesth. 2004;92:121–130.
3. Brown DF, Edwards DI, Hawkey PM, Morrison D, Ridgway GL, Towner KJ, et al. Guidelines for the laboratory diagnosis and susceptibility testing of methicillin-resistant

Staphylococcus aureus (MRSA). J Antimicrob Chemother. 2005;56:1000–1018.

4. Anupurba S, Sen MR, Nath G, Sharma BM, Gulati AK, Mohapatra TM. Prevalence of methicillin resistant Staphylococcus aureus in a tertiary referral hospital in eastern Uttar Pradesh. Indian J Med Microbiol. 2003;21:49–51.
5. Rasigade JP, Vandenesch F. Staphylococcus aureus: a pathogen with still unresolved issues. Infect Genet Evol. 2014;21:510–514.
6. Centers for Disease Control and Prevention (CDC). Outbreaks of community-associated methicillin-resistant Staphylococcus aureus skin infections — Los Angeles County, California, 2002–2003. MMWR Morb Mortal Wkly Rep. 2003;52(5):88.
7. Boucher HW, Corey GR. Epidemiology of methicillin-resistant Staphylococcus aureus. Clin Infect Dis. 2008;46(Suppl 5):S344–349.
8. Chambers HF. Community-associated MRSA — resistance and virulence converge. N Engl J Med. 2005;352(14):1485–1487.
9. Tong SY, Davis JS, Eichenberger E, Holland TL, Fowler VG. Staphylococcus aureus infections: epidemiology, pathophysiology, clinical manifestations, and management. Clin Microbiol Rev. 2015;28(3):603–661.
10. DeLeo FR, Diep BA, Otto M. Host defense and pathogenesis in Staphylococcus aureus infections. Infect Dis Clin North Am. 2009;23(1):17–34.
11. Otto M, et al. Epidemiology and pathogenesis of MRSA bacteremia. (as cited in thesis literature review, 2015).
12. Foster TJ. Immune evasion by staphylococci. Nat Rev Microbiol. 2005;3(12):948–958.
13. Salgado-Pabón W, Breshears L, Spaulding AR, Merriman JA, Stach CS, Horswill AR, Peterson ML, Schlievert PM. Superantigens are critical for Staphylococcus aureus infective endocarditis, sepsis, and acute kidney injury. mBio. 2013;4(4).
14. Musser JM, Schlievert PM, Chow AW, Ewan P, Kreiswirth BN, Rosdahl VT, Naidu AS, Witte W, Selander RK. A single clone of Staphylococcus aureus causes the majority of cases of toxic shock syndrome. Proc Natl Acad Sci U S A. 1990;87(1):225–229.
15. Le KY, Otto M. Quorum-sensing regulation in staphylococci — an overview. Front Microbiol. 2015.
16. Dilnessa T, Bitew A. Prevalence and antimicrobial susceptibility pattern of Staphylococcus aureus. (as cited in thesis literature review, 2016).
17. Qodrati M, SeyedAlinaghi S, et al. Antimicrobial resistance patterns of Staphylococcus aureus, 2018–2019 surveillance data. (as cited in thesis literature review, 2022).
18. Waitayangkoon P, et al. Factors affecting antimicrobial therapy success in S. aureus

infections. (as cited in thesis literature review, 2020).

19. Kourtis AP, et al. Vital signs: epidemiology and recent trends in methicillin-resistant and susceptible Staphylococcus aureus bloodstream infections. MMWR. 2019.
20. Fairbrother J. Antimicrobial resistance in Staphylococcus aureus and infection control implications. (as cited in thesis introduction, 2014).