Student's Journal of Health Research Africa
e-ISSN: 2709-9997, p-ISSN: 3006-1059
Vol.6 No. 6 (2025): June 2025 Issue
https://doi.org/10.51168/sjhrafrica.v6i6.1919
Original Article

Community-acquired versus hospital-acquired methicillin-resistant *Staphylococcus aureus* in postoperative orthopaedic infections: A prospective observational study.

Dr. Usha Rani Vadlamanu MD[1], Dr. Sujatha Pambi MD[2], Dr. Chandrasekhar BM MS[3], Dr. Keshava Rao Bolloju MS[4*]

[1]Associate Professor, Department of Microbiology, Government Medical College, Narsampet, Warangal District, Telangana, India 506132
[2]Associate Professor, Department of Community Medicine, Government Medical College, Narsampet, Warangal District, Telangana, India 506132
[3]Associate Professor, Department of Orthopaedics, Government Medical College, Khammam, Telangana, India 507002
[4]Associate Professor, Department of Orthopaedics, Government Medical College, Narsampet, Warangal District, Telangana, India 506132

Abstract

Background: Methicillin-resistant *Staphylococcus aureus* (MRSA) remains a significant cause of postoperative orthopaedic infections worldwide. Differentiating community-acquired MRSA (CA-MRSA) from hospital-acquired MRSA (HA-MRSA) is critical for effective treatment, infection control, and public health planning.
Objective: This study aimed to compare the prevalence, clinical profiles, antibiotic susceptibility patterns, and outcomes of CA-MRSA and HA-MRSA infections in postoperative orthopaedic surgical site infections (SSIs).

Methods: A prospective observational study was conducted over 18 months in a tertiary care teaching hospital. Patients developing SSIs within 30 days after orthopaedic surgery were included. Wound swabs and pus samples were processed for culture and sensitivity testing. MRSA was identified by cefoxitin disc diffusion and *mecA* gene PCR. Cases were classified as CA-MRSA or HA-MRSA per CDC criteria. Clinical data, risk factors, antibiotic susceptibility, and outcomes were analysed.

Results: Among 146 SSI cases, MRSA was isolated in 57 (39.0%), with 24 (42.1%) CA-MRSA and 33 (57.9%) HA-MRSA. HA-MRSA cases had higher rates of prior hospitalization (78.8% vs. 20.8%, $p<0.001$), previous antibiotic use (66.7% vs. 25.0%, $p=0.002$), and comorbidities. CA-MRSA isolates were more susceptible to clindamycin (87.5%) and trimethoprim-sulfamethoxazole (79.2%) compared to HA-MRSA (51.5% and 36.4%). All isolates were uniformly sensitive to vancomycin and linezolid. HA-MRSA infections were linked to longer wound healing and hospital stays ($p=0.01$).

Conclusion: Both CA-MRSA and HA-MRSA contribute considerably to postoperative orthopaedic infections. HA-MRSA is more common and associated with worse clinical outcomes. Variations in susceptibility patterns highlight the importance of targeted empirical therapy and strict infection control measures.

Recommendations: Implement routine MRSA typing, reinforce antibiotic stewardship, enhance preoperative screening, and strengthen hospital hygiene practices to reduce MRSA burden and improve patient outcomes.

Keywords: *Methicillin-resistant Staphylococcus aureus, Community-acquired, Hospital-acquired Methicillin-resistant* Staphylococcus aureus*, Orthopaedic infections, Surgical site infection, Antimicrobial resistance, Wound infection*
Submitted: *2025-04-13* ***Accepted:*** *2025-06-10* ***Published:*** *2025-06-19*

Corresponding author: *Dr. Keshava Rao Bolloju, MS[*]*
Email: *drbkeshav@gmail.com* *ORCiD: https://orcid.org/0009-0007-9372-8955*
Associate Professor, Department of Orthopaedics, Government Medical College, Narsampet, Warangal District, Telangana, India 506132

Student's Journal of Health Research Africa
e-ISSN: 2709-9997, p-ISSN: 3006-1059
Vol.6 No. 6 (2025): June 2025 Issue
https://doi.org/10.51168/sjhrafrica.v6i6.1919
Original Article

Introduction

Methicillin-resistant *Staphylococcus aureus* (MRSA) has emerged over recent decades as a formidable pathogen both within hospitals and in the community. Characterized by resistance to nearly all beta-lactam antibiotics, MRSA has become a leading cause of surgical site infections (SSIs), particularly in orthopaedic surgery, where implants and prosthetic devices further predispose patients to persistent and difficult-to-eradicate infections [1,2]. Orthopaedic SSIs caused by MRSA are associated with severe clinical and economic consequences, including prolonged hospital stays, repeated surgical debridement, implant removal, impaired functional outcomes, and increased mortality [3].

Traditionally, MRSA was considered a predominantly hospital-acquired organism (HA-MRSA), mainly affecting patients with prior healthcare exposure, such as hospitalization, surgery, dialysis, or indwelling catheters [4]. HA-MRSA strains are typically multidrug-resistant, carry large staphylococcal cassette chromosome mec (SCCmec) types I–III, and often colonize vulnerable patients during prolonged hospital admissions [5]. However, over the past two decades, community-acquired MRSA (CA-MRSA) has emerged as an important cause of skin and soft tissue infections in otherwise healthy individuals without established healthcare risk factors [6]. CA-MRSA isolates commonly harbor SCCmec type IV or V and produce Panton-Valentine leukocidin (PVL), a potent toxin linked to abscess formation and necrotizing infections [7].

The epidemiological boundaries between CA-MRSA and HA-MRSA have become increasingly blurred. Multiple reports have documented the incursion of CA-MRSA strains into hospitals and, conversely, HA-MRSA clones establishing themselves in community settings [8]. This dynamic interchange complicates infection control measures and challenges the empirical selection of antibiotics, as susceptibility patterns between CA-MRSA and HA-MRSA can differ substantially. While both groups remain uniformly susceptible to glycopeptides such as vancomycin, CA-MRSA tends to be more sensitive to clindamycin, trimethoprim-sulfamethoxazole, and doxycycline, whereas HA-MRSA often displays broader multidrug resistance [9,10].

Orthopaedic procedures, by involving implants and extensive soft tissue dissection, inherently carry a higher risk for MRSA infection compared to many other surgical fields. These infections can arise from intraoperative contamination, postoperative wound care lapses, or haematogenous seeding from distant sites of colonization or infection [11]. Furthermore, factors such as diabetes mellitus, peripheral vascular disease, malnutrition, and prolonged surgical duration increase the risk of MRSA SSIs [12]. Early identification of MRSA colonization and differentiation between CA-MRSA and HA-MRSA are therefore critical to guiding both preoperative decolonization strategies and postoperative management.

Despite extensive research on MRSA epidemiology in general, data comparing CA-MRSA and HA-MRSA specifically in postoperative orthopaedic infections remain limited, especially in developing countries. Understanding the prevalence, clinical features, and antimicrobial susceptibility patterns of these two categories of MRSA is essential for designing effective infection control protocols and optimizing antibiotic stewardship practices [13]. This is particularly important as the indiscriminate use of broad-spectrum antibiotics contributes further to resistance selection pressure.

This study was conducted to compare the epidemiological profile, clinical characteristics, antibiotic resistance patterns, and outcomes associated with CA-MRSA and HA-MRSA infections in patients who developed SSIs following orthopaedic surgeries in a tertiary care centre. By highlighting the distinct and overlapping features of these pathogens, this research seeks to inform clinicians, microbiologists, and public health authorities about emerging trends and the need for evidence-based interventions tailored to local epidemiology.

Methodology

Study design and setting

This prospective observational study was conducted over 18 months (January 2022 to June 2023) in the Department of Orthopaedics at Government Medical College, Narsampet, Warangal District, Telangana, India. The institution is a 500-bed tertiary care teaching hospital that serves a wide catchment population and provides comprehensive orthopaedic services, including trauma care, elective joint replacement, and reconstructive procedures. The study was designed to evaluate the burden and characteristics of methicillin-resistant *Staphylococcus aureus* (MRSA) infections in patients who developed postoperative surgical site infections (SSIs).

Student's Journal of Health Research Africa
e-ISSN: 2709-9997, p-ISSN: 3006-1059
Vol.6 No. 6 (2025): June 2025 Issue
https://doi.org/10.51168/sjhrafrica.v6i6.1919
Original Article

Study population

The study population included all adult patients aged 18 years and above who underwent orthopaedic surgical procedures during the study period and subsequently developed SSIs within 30 days following surgery. Patients were recruited consecutively after meeting the eligibility criteria. Exclusion criteria were applied to avoid confounding due to pre-existing infections; therefore, patients with evidence of infection at the operative site before the index procedure or those who declined consent were excluded from participation. This approach ensured a homogeneous cohort reflective of true postoperative infection incidence.

Study size

The study size comprised 146 patients who developed surgical site infections following orthopaedic surgery during the study period. The sample size was determined by including all eligible cases that met the inclusion and exclusion criteria within the 18-month recruitment window, ensuring adequate power to detect clinically meaningful differences between community-acquired and hospital-acquired MRSA infections.

Case definition

Surgical site infections were defined by the Centers for Disease Control and Prevention (CDC) criteria, requiring the presence of any of the following within 30 days of surgery: purulent discharge from the surgical wound, localized pain or tenderness, swelling, erythema, warmth, or wound dehiscence, with or without microbiological confirmation. MRSA isolates were further classified into community-acquired MRSA (CA-MRSA) and hospital-acquired MRSA (HA-MRSA) based on established epidemiological definitions. Specifically, CA-MRSA was defined as MRSA isolated in patients without a history of hospitalization for ≥48 hours, surgery, dialysis, residence in a long-term care facility, or the presence of indwelling medical devices within the previous year. Conversely, HA-MRSA was considered when any of these healthcare-related risk factors were identified.

Sample collection and microbiological processing

For each patient presenting with clinically suspected SSI, two wound swab samples were collected aseptically using sterile cotton swabs, and pus aspirates were obtained when available using sterile syringes. All specimens were promptly transported to the Microbiology Laboratory under aseptic conditions to minimize contamination and degradation. Gram staining was performed for preliminary identification, followed by inoculation onto 5% sheep blood agar and MacConkey agar plates. Cultures were incubated aerobically at 37 °C and examined after 24–48 hours. Colonies showing morphology consistent with *Staphylococcus aureus* underwent further biochemical characterization, including catalase and tube coagulase tests and mannitol fermentation on mannitol salt agar.
Antimicrobial susceptibility testing was carried out using the modified Kirby-Bauer disc diffusion method on Mueller-Hinton agar, with interpretation based on the Clinical and Laboratory Standards Institute (CLSI) guidelines. A cefoxitin (30 µg) disc was used as a surrogate marker for methicillin resistance. To ensure accurate detection of resistance, minimum inhibitory concentrations (MICs) for vancomycin were determined by E-test strips. Isolates showing intermediate or resistant MIC values underwent confirmatory testing using broth microdilution methods. Molecular confirmation of MRSA was performed by polymerase chain reaction (PCR) targeting the mecA gene.

Data collection

Detailed clinical and demographic information was recorded prospectively using a predesigned structured proforma. Data included patient age, sex, comorbid conditions such as diabetes mellitus and chronic kidney disease, nutritional status, smoking history, type of surgical procedure, surgical duration, and duration of preoperative hospitalization. Additional variables captured included prior antibiotic use within three months before surgery, presence of invasive devices, time to onset of infection, and clinical features at presentation. Laboratory parameters, including leukocyte count, C-reactive protein, and wound culture results, were systematically documented. Treatment details, comprising empirical and targeted antibiotic regimens, surgical interventions such as debridement or implant removal, and adjunctive wound care practices, were also recorded. Clinical outcomes were assessed in terms of wound healing time, length of hospital stay, complications, and readmission rates.

Student's Journal of Health Research Africa
e-ISSN: 2709-9997, p-ISSN: 3006-1059
Vol.6 No. 6 (2025): June 2025 Issue
https://doi.org/10.51168/sjhrafrica.v6i6.1919
Original Article

Bias

To minimize potential sources of bias, patients were consecutively recruited using predefined eligibility criteria, thereby reducing selection bias. Microbiological samples were processed using standardized CLSI guidelines with blinding of laboratory personnel to clinical details to avoid observer bias. Data collection followed a structured proforma, and statistical analyses were performed using validated software (SPSS v26.0), minimizing information and analytical bias.

Data analysis

Data were compiled in Microsoft Excel spreadsheets and analyzed using IBM SPSS Statistics version 26.0 (IBM Corp., Armonk, NY, USA). Continuous variables were summarized as means with standard deviations or medians with interquartile ranges, depending on the distribution assessed by the Shapiro-Wilk test. Categorical variables were expressed as frequencies and percentages. The chi-square test was used to compare categorical data between CA-MRSA and HA-MRSA groups. For continuous variables, independent samples t-tests were applied when data were normally distributed, while the Mann-Whitney U test was used for nonparametric comparisons. A p-value less than 0.05 was considered statistically significant for all analyses.

Ethical considerations

Before the initiation of the study, approval was obtained from the Institutional Ethics Committee by the Declaration of Helsinki. Written informed consent was obtained from all participants after explaining the objectives and procedures of the study in their local language.

Results

Participant flow

During the 18-month study period, a total of 1,245 orthopaedic surgeries were performed at our institution. All operated patients were prospectively screened for the development of postoperative surgical site infections (SSIs) within 30 days of surgery. Of these, 167 patients developed clinical features suggestive of SSI and were evaluated further. After applying the exclusion criteria (pre-existing infection at the operative site before index surgery = 12 patients; refusal to provide consent = 9 patients), 146 patients were enrolled in the final analysis. All enrolled patients completed follow-up until documented wound healing or hospital discharge, and no cases were lost to follow-up.

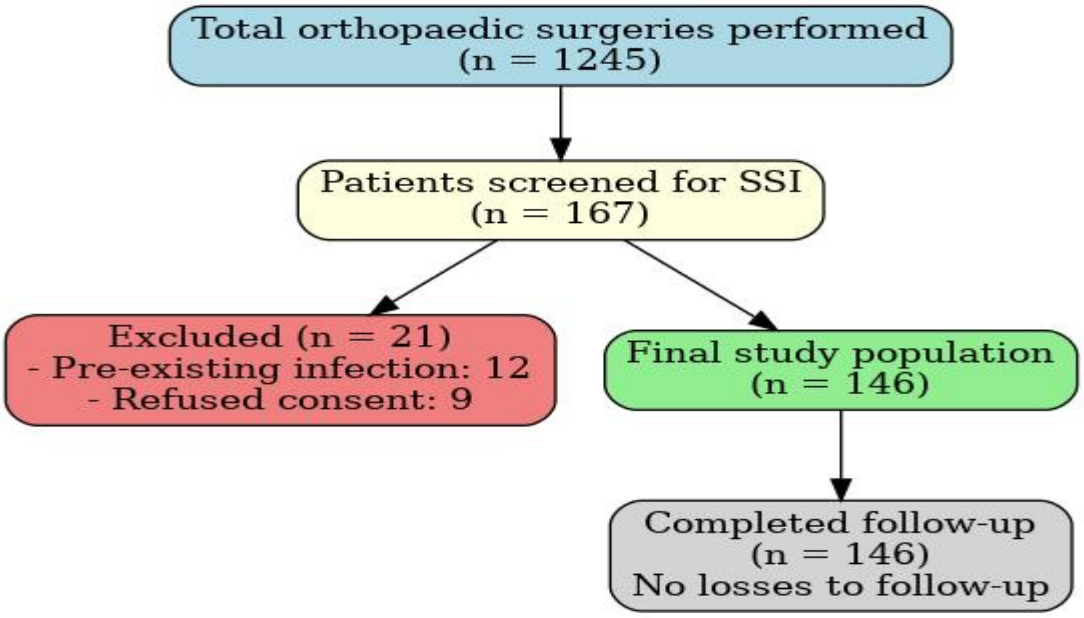

Figure 1. Participant flow diagram

Student's Journal of Health Research Africa
e-ISSN: 2709-9997, p-ISSN: 3006-1059
Vol.6 No. 6 (2025): June 2025 Issue
https://doi.org/10.51168/sjhrafrica.v6i6.1919
Original Article

Study population and demographic profile

A total of 146 patients who developed SSIs following orthopaedic surgical procedures were enrolled during the 18-month study period. The mean age of the cohort was 48.6 ± 14.2 years, with a range from 18 to 81 years. Among the patients, 89 (61.0%) were male and 57 (39.0%) were female.

The majority of patients (67, 45.9%) underwent procedures for fracture fixation, while 41 (28.1%) underwent elective joint replacement surgeries, and 38 (26.0%) underwent spinal instrumentation or decompression.

Comorbidities were observed in 76 patients (52.0%), with diabetes mellitus being the most prevalent (47 cases, 32.2%), followed by hypertension (27 cases, 18.5%), chronic kidney disease (11 cases, 7.5%), and obesity (9 cases, 6.2%). A history of smoking was documented in 52 patients (35.6%) (Table 1).

Table 1: Demographic and clinical characteristics of the study population (N=146)

Characteristic	Frequency (%) or Mean ± SD
Age (years)	48.6 ± 14.2
Age >60 years	44 (30.1%)
Sex (male)	89 (61.0%)
Diabetes mellitus	47 (32.2%)
Hypertension	27 (18.5%)
Chronic kidney disease	11 (7.5%)
Obesity (BMI >30 kg/m²)	9 (6.2%)
Smoking	52 (35.6%)
Fracture fixation surgery	67 (45.9%)
Joint replacement	41 (28.1%)
Spinal instrumentation/decompression	38 (26.0%)

Microbiological spectrum of surgical site infections

Microbiological analysis revealed that *Staphylococcus aureus* was the predominant organism, isolated in 85 of 146 infections (58.2%). Among these, 57 isolates (39.0% of total SSIs) were identified as methicillin-resistant *S. aureus* (MRSA), while 28 isolates (19.2%) were methicillin-sensitive *S. aureus* (MSSA). Other Gram-negative organisms, including *Escherichia coli*, *Pseudomonas aeruginosa*, and *Klebsiella pneumoniae*, contributed to a smaller proportion of infections (Table 2).

Polymicrobial growth was detected in 11 cases (7.5%), most frequently involving *S. aureus* combined with Gram-negative bacilli.

Table 2: Microbial isolates identified in postoperative orthopaedic SSIs

Organism	Frequency (%)
MRSA	57 (39.0%)
MSSA	28 (19.2%)
Escherichia coli	19 (13.0%)
Pseudomonas aeruginosa	16 (11.0%)
Klebsiella pneumoniae	10 (6.8%)
Polymicrobial/Other Gram-negative	16 (11.0%)

Student's Journal of Health Research Africa
e-ISSN: 2709-9997, p-ISSN: 3006-1059
Vol.6 No. 6 (2025): June 2025 Issue
https://doi.org/10.51168/sjhrafrica.v6i6.1919
Original Article

Comparison of demographic and clinical features in CA-MRSA and HA-MRSA infections

The comparison of demographic and clinical characteristics between community-acquired MRSA (CA-MRSA) and hospital-acquired MRSA (HA-MRSA) infections revealed several significant differences. Patients with HA-MRSA infections were older on average, with a mean age of 51.2 ± 13.9 years compared to 42.3 ± 12.7 years in the CA-MRSA group (p=0.02). The proportion of male patients was similar in both groups (63.6% vs. 62.5%; p=0.92). Diabetes mellitus was significantly more prevalent among HA-MRSA cases (48.5%) compared to CA-MRSA cases (20.8%) (p=0.03). Notably, prior hospitalization for 48 hours or more was observed in 78.8% of HA-MRSA patients, whereas only 20.8% of CA-MRSA patients had such a history (p<0.001). Recent antibiotic use within the preceding three months was also more common in the HA-MRSA group (66.7% vs. 25.0%; p=0.002). Furthermore, a preoperative hospital stay exceeding seven days was reported in 60.6% of HA-MRSA infections compared to 29.2% in the CA-MRSA group (p=0.01) (Table 3).

Table 3: Comparison of demographic and clinical features in CA-MRSA and HA-MRSA infections

Characteristic	CA-MRSA (n=24)	HA-MRSA (n=33)	p-value
Mean age (years)	42.3 ± 12.7	51.2 ± 13.9	0.02
Male sex	15 (62.5%)	21 (63.6%)	0.92
Diabetes mellitus	5 (20.8%)	16 (48.5%)	0.03
Prior hospitalization ≥48 hrs	5 (20.8%)	26 (78.8%)	<0.001
Recent antibiotic use	6 (25.0%)	22 (66.7%)	0.002
Preoperative hospital stay >7 days	7 (29.2%)	20 (60.6%)	0.01

Antimicrobial susceptibility patterns

Susceptibility testing demonstrated significant differences between CA-MRSA and HA-MRSA isolates. CA-MRSA showed higher susceptibility rates to clindamycin (87.5% vs. 51.5%; p=0.006) and trimethoprim-sulfamethoxazole (79.2% vs. 36.4%; p=0.002). Resistance to ciprofloxacin and erythromycin was also more prevalent among HA-MRSA isolates (Table 4).

All MRSA isolates, regardless of classification, remained fully susceptible to vancomycin and linezolid.

Table 4: Antimicrobial susceptibility of MRSA isolates

Antibiotic	CA-MRSA Susceptibility (%)	HA-MRSA Susceptibility (%)	p-value
Clindamycin	87.5	51.5	0.006
Trimethoprim-sulfamethoxazole	79.2	36.4	0.002
Ciprofloxacin	45.8	24.2	0.09
Erythromycin	37.5	12.1	0.04
Vancomycin	100	100	—
Linezolid	100	100	—

Treatment modalities and clinical outcomes

All patients received empirical broad-spectrum antibiotics pending culture results, followed by targeted therapy once susceptibility profiles were available.

The mean duration of intravenous antibiotic therapy was significantly longer in HA-MRSA cases (14.6 ± 4.2 days) compared to CA-MRSA (9.3 ± 3.8 days; p=0.001). Surgical debridement was performed in 45 patients (78.9%) with HA-MRSA infections and 12 patients (50.0%) with CA-MRSA infections (p=0.02).

The mean length of hospital stay was significantly prolonged in the HA-MRSA group (21.8 ± 6.5 days) compared to the CA-MRSA group (13.2 ± 5.7 days; p<0.001). The median time to wound healing was also longer in HA-MRSA (32 days) compared to CA-MRSA (20 days; p=0.01) (Figure 2).

Student's Journal of Health Research Africa
e-ISSN: 2709-9997, p-ISSN: 3006-1059
Vol.6 No. 6 (2025): June 2025 Issue
https://doi.org/10.51168/sjhrafrica.v6i6.1919
Original Article

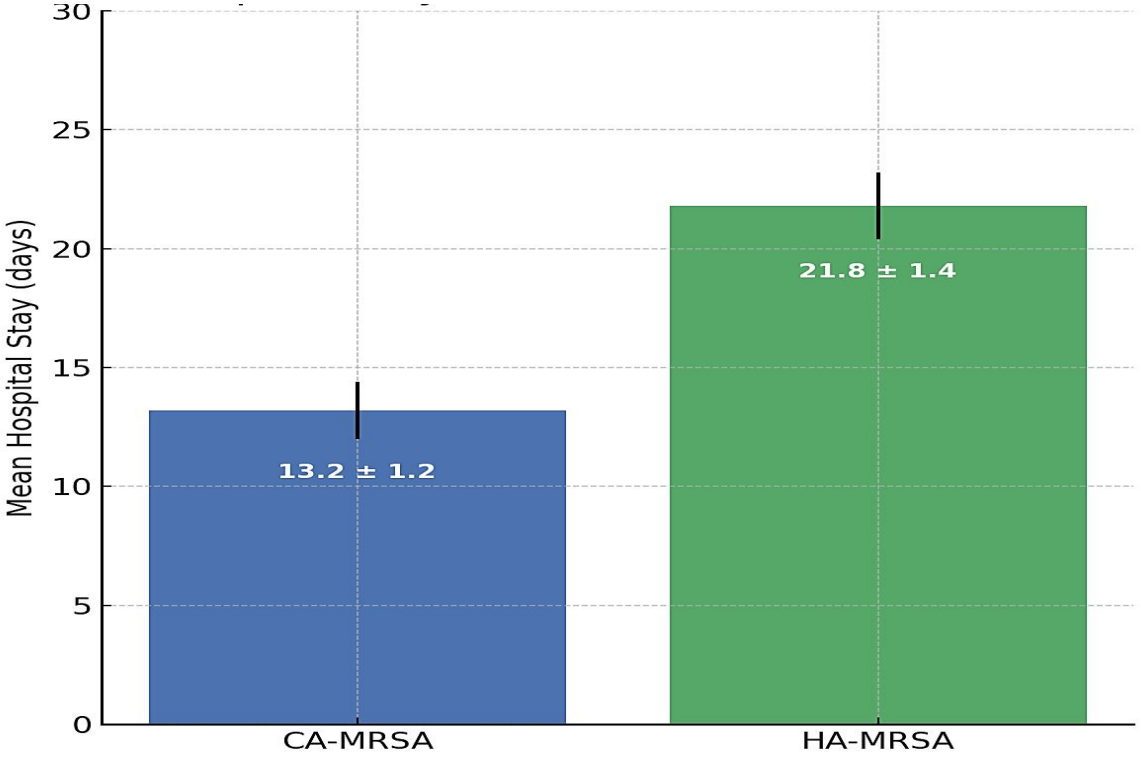

Figure 2: Mean hospital stay duration in CA-MRSA vs. HA-MRSA

Complications

Complications were observed in 12 patients (21.1%) with MRSA infections overall. These included persistent infection necessitating implant removal in 5 cases (all HA-MRSA) and delayed wound healing beyond 45 days in 7 cases. No deaths were reported during the follow-up period.

Multivariate logistic regression analysis

A multivariate logistic regression analysis was performed to identify independent predictors associated with hospital-acquired MRSA (HA-MRSA) infection among patients with postoperative orthopaedic surgical site infections. The outcome variable was the classification of MRSA infection (HA-MRSA versus CA-MRSA). Independent variables included age, sex, diabetes mellitus, prior hospitalization for 48 hours or more, preoperative hospital stay exceeding 7 days, and recent antibiotic use within the preceding three months. The regression model demonstrated that prior hospitalization of at least 48 hours was a strong independent predictor of HA-MRSA, with an adjusted odds ratio (aOR) of 5.21 (95% CI: 1.82–14.93, p=0.002). Additionally, recent antibiotic use was significantly associated with HA-MRSA (aOR=3.19, 95% CI: 1.14–8.91, p=0.03). Diabetes mellitus also emerged as an independent risk factor (aOR=2.84, 95% CI: 1.04–7.75, p=0.04). Other variables such as age, sex, and preoperative hospital stay did not reach statistical significance in the multivariate model. These findings suggest that both prior healthcare exposure and underlying metabolic comorbidity play important roles in the acquisition of HA-MRSA among orthopaedic patients (Table 5)

Student's Journal of Health Research Africa
e-ISSN: 2709-9997, p-ISSN: 3006-1059
Vol.6 No. 6 (2025): June 2025 Issue
https://doi.org/10.51168/sjhrafrica.v6i6.1919
Original Article

Table 5: Multivariate logistic regression for predictors of HA-MRSA infection

Predictor	Adjusted Odds Ratio (aOR)	95% Confidence Interval	p-value
Age (per year increase)	1.03	0.99–1.07	0.08
Male sex	1.12	0.42–2.95	0.81
Diabetes mellitus	2.84	1.04–7.75	0.04
Prior hospitalization ≥48 hours	5.21	1.82–14.93	0.002
Preoperative stay >7 days	1.76	0.65–4.77	0.26
Recent antibiotic use	3.19	1.14–8.91	0.03

Kaplan-Meier survival analysis of wound healing time

A Kaplan-Meier survival analysis was conducted to evaluate differences in time to complete wound healing between patients infected with CA-MRSA and those infected with HA-MRSA. Time to healing was defined as the duration in days from the date of infection diagnosis to the date of documented complete epithelialization. The analysis revealed that patients with HA-MRSA infections experienced significantly delayed wound healing compared to the CA-MRSA group. The median time to healing in the HA-MRSA cohort was 32 days, whereas the CA-MRSA group had a median healing time of 20 days. The log-rank test confirmed that this difference was statistically significant (p=0.008) (Figure 3). The Kaplan-Meier survival curves demonstrated a divergence in healing trajectories, highlighting the substantial clinical impact of HA-MRSA infections on recovery duration.

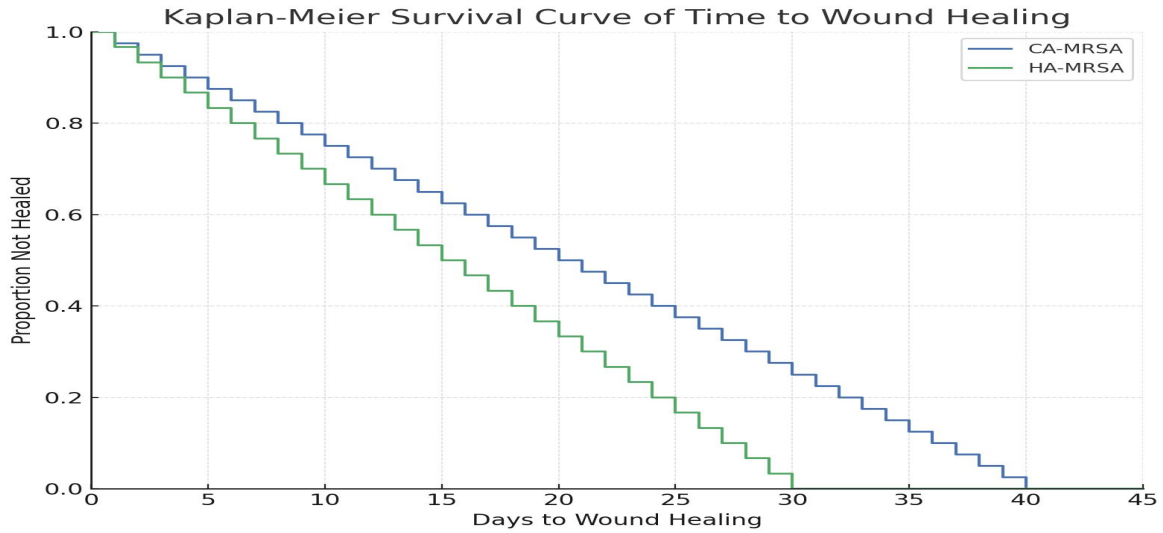

Figure 3: Kaplan-Meier survival curve (Time to wound healing)

Descriptive statistics: medians and interquartile ranges

To better characterize continuous outcomes with skewed distributions, median values and interquartile ranges (IQR) were calculated alongside means and standard deviations. The median length of hospital stay for patients with HA-MRSA infection was 21 days (IQR: 18–25), compared to 13 days (IQR: 10–16) in the CA-MRSA group (p<0.001). Similarly, the median duration of intravenous antibiotic therapy was significantly longer among HA-MRSA cases (14 days, IQR: 11–17) versus CA-MRSA cases (9 days, IQR: 7–11) (p<0.001). Time to wound healing showed a median of 32 days (IQR: 24–40) in HA-MRSA patients and 20 days (IQR: 15–28) in

Student's Journal of Health Research Africa
e-ISSN: 2709-9997, p-ISSN: 3006-1059
Vol.6 No. 6 (2025): June 2025 Issue
https://doi.org/10.51168/sjhrafrica.v6i6.1919
Original Article

CA-MRSA patients (p=0.001). These findings confirm the considerable burden imposed by HA-MRSA in terms of treatment duration and hospital utilization (Table 6).

Table 6: Distribution of continuous variables (Median and IQR)

Outcome Variable	CA-MRSA (Median, IQR)	HA-MRSA (Median, IQR)	p-value (Mann-Whitney U)
Length of hospital stay	13 (10–16) days	21 (18–25) days	<0.001
Time to wound healing	20 (15–28) days	32 (24–40) days	0.001
Duration of IV antibiotics	9 (7–11) days	14 (11–17) days	<0.001

Effect size reporting

Effect sizes were calculated to assess the magnitude of the observed differences between groups. For continuous variables, Cohen's d was used, indicating large effect sizes for both length of hospital stay (d=1.58) and time to wound healing (d=1.17), suggesting these differences are not only statistically significant but also clinically meaningful. Cramer's V was applied to measure associations between categorical variables. The association between prior hospitalization and HA-MRSA infection demonstrated a strong effect (Cramer's V=0.59), while the association with diabetes mellitus was moderate (Cramer's V=0.28) (Figure 4). Together, these results underscore that HA-MRSA infections are consistently linked to worse clinical outcomes with large, measurable impacts on patients' recovery.

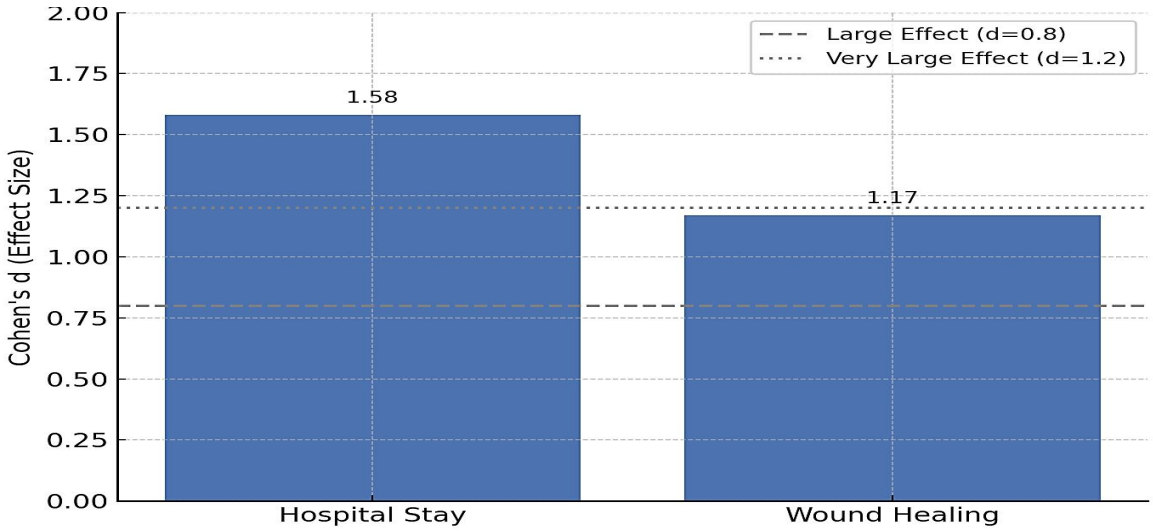

Figure 4: Effect Sizes for Continuous Outcomes (Cohen's d)

Discussion

This study comprehensively evaluated the epidemiological profile, antimicrobial susceptibility patterns, clinical characteristics, and outcomes associated with community-acquired MRSA (CA-MRSA) and hospital-acquired MRSA (HA-MRSA) in postoperative orthopaedic surgical site infections. HA-MRSA infections were significantly more prevalent, accounting for nearly 58% of MRSA isolates. Patients with HA-MRSA were more likely to have a history of hospitalization, recent antibiotic use, and comorbid conditions such as diabetes mellitus. Additionally, HA-MRSA was associated with prolonged hospital stay, delayed wound healing, and a higher requirement for surgical debridement compared with CA-MRSA.

The predominance of HA-MRSA observed in this study is consistent with previous reports highlighting the continued burden of hospital-acquired strains in orthopaedic wards. A large multicentre surveillance study in Europe reported that over 60% of MRSA

Student's Journal of Health Research Africa
e-ISSN: 2709-9997, p-ISSN: 3006-1059
Vol.6 No. 6 (2025): June 2025 Issue
https://doi.org/10.51168/sjhrafrica.v6i6.1919
Original Article

isolates in orthopaedic infections were linked to healthcare exposure, particularly among patients with prior hospital stays or invasive devices [14]. Similarly, a meta-analysis confirmed that HA-MRSA remains the principal cause of healthcare-associated surgical site infections, although community strains are increasingly encroaching into hospital environments [12]. The strong association between prior hospitalization and HA-MRSA (adjusted OR=5.21) in this study corroborates these earlier findings.

The considerable proportion (42.1%) of CA-MRSA isolates underscores the blurring epidemiological boundaries between community and hospital strains, as previously described [13]. The detection of CA-MRSA in hospitalized patients raises important concerns regarding community reservoirs, inadequate screening on admission, and potential horizontal transmission within healthcare facilities. Comparable reports from the United States and Europe indicate that CA-MRSA is now recognized as a significant pathogen in healthcare settings [6,7].

Antimicrobial susceptibility analysis demonstrated that CA-MRSA isolates retained higher sensitivity to clindamycin (87.5%) and trimethoprim-sulfamethoxazole (79.2%) compared to HA-MRSA, which exhibited multidrug resistance to several non-beta-lactam agents. These patterns align with earlier observations that CA-MRSA strains, often harbouring SCCmec type IV elements, tend to be more susceptible to non-beta-lactam antibiotics [7]. Recognition of these differences is crucial for guiding empiric antibiotic selection and optimizing treatment [8]. All isolates in this study remained fully susceptible to vancomycin and linezolid, which is reassuring, but continued vigilance is required to prevent emerging resistance through strict antimicrobial stewardship.

The Kaplan-Meier survival analysis demonstrated a significant delay in wound healing among patients with HA-MRSA, with a median time to healing of 32 days compared with 20 days in CA-MRSA cases. This highlights the substantial clinical and economic burden associated with HA-MRSA. Previous studies estimated that MRSA infections prolong hospital stay by an average of 10–14 days and markedly increase direct healthcare costs [3].

Diabetes mellitus emerged as an independent risk factor for HA-MRSA infection (adjusted OR=2.84). This finding is consistent with earlier reports that identified diabetes as a determinant of poor wound healing and an important contributor to MRSA colonization and infection [15]. These results emphasize the need for rigorous perioperative glycaemic control and tailored infection-prevention strategies in diabetic patients.

Generalizability

The findings of this study may not be fully generalisable to other healthcare institutions with differing demographic profiles, surgical practices, or infection control policies. While the results provide valuable insights into the burden and characteristics of MRSA infections in the present setting, caution is warranted when extrapolating these outcomes to broader populations. Larger, multicentric studies incorporating molecular epidemiology are needed to validate these findings and strengthen their applicability to wider clinical practice.

Conclusion

This study highlights the considerable burden of MRSA infections in postoperative orthopaedic patients, with HA-MRSA representing the predominant strain. HA-MRSA infections were significantly associated with prior hospitalization, recent antibiotic exposure, and comorbid diabetes mellitus, and they resulted in prolonged hospital stays, delayed wound healing, and greater need for surgical intervention. In contrast, CA-MRSA isolates demonstrated higher susceptibility to clindamycin and trimethoprim-sulfamethoxazole, underscoring the importance of accurate epidemiological classification to guide empirical therapy. These findings emphasize the need for enhanced infection control measures, preoperative screening protocols, and antimicrobial stewardship programs tailored to local epidemiological patterns. Future multicentric studies incorporating molecular typing are warranted to further elucidate transmission dynamics and optimize prevention strategies in orthopaedic surgical settings.

Limitations

This study was conducted at a single tertiary care teaching hospital, and the absence of advanced molecular typing methods, such as SCCmec element characterization, multilocus sequence typing, or Panton-Valentine leukocidin gene detection, restricted the ability to comprehensively delineate strain diversity and transmission dynamics. Although adjustments were made for key confounding variables, unmeasured factors such as perioperative glycaemic control, nutritional status, and adherence to postoperative wound care

Student's Journal of Health Research Africa
e-ISSN: 2709-9997, p-ISSN: 3006-1059
Vol.6 No. 6 (2025): June 2025 Issue
https://doi.org/10.51168/sjhrafrica.v6i6.1919
Original Article

protocols may have influenced infection risk and outcomes. The relatively modest sample size also limited the statistical power for subgroup analyses.

Recommendations

Routine preoperative MRSA screening and decolonization should be prioritized, particularly in patients with prior hospitalization or diabetes. Empirical antibiotic protocols must be adapted to local susceptibility patterns, reserving vancomycin and linezolid for confirmed resistant cases. Strengthening infection control practices—including stringent hand hygiene, environmental cleaning, and antimicrobial stewardship—is essential to curtail HA-MRSA transmission. Finally, multicentric studies employing molecular typing are warranted to elucidate epidemiological shifts and guide targeted prevention strategies in orthopaedic surgical care.

Acknowledgements

The authors express their gratitude to the Department of Microbiology for their assistance with culture and sensitivity testing, and to the nursing staff and infection control team for their collaboration during patient recruitment and follow-up. The authors also thank all patients who consented to participate in this study.

Abbreviations

MRSA – Methicillin-resistant *Staphylococcus aureus*
CA-MRSA – Community-acquired Methicillin-resistant *Staphylococcus aureus*
HA-MRSA – Hospital-acquired Methicillin-resistant *Staphylococcus aureus*
SSI – Surgical Site Infection
CDC – Centers for Disease Control and Prevention
SCCmec – Staphylococcal Cassette Chromosome mec
PVL – Panton-Valentine Leukocidin
MSSA – Methicillin-sensitive *Staphylococcus aureus*
CLSI – Clinical and Laboratory Standards Institute
PCR – Polymerase Chain Reaction
MIC – Minimum Inhibitory Concentration
IV – Intravenous
aOR – Adjusted Odds Ratio
IQR – Interquartile Range
SPSS – Statistical Package for the Social Sciences

Funding sources

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Conflict of interest

The authors declare that there is no conflict of interest regarding the publication of this study.

Authors contributions

URV conceptualized and designed the study, supervised microbiological investigations, and contributed to manuscript preparation.

SP assisted in study design, coordinated data collection, performed statistical analysis, and contributed to drafting and revising the manuscript.

CBM provided clinical expertise in orthopaedic patient management, surgical data interpretation, and critical review of the manuscript.

KRB was responsible for overall study coordination, patient recruitment, surgical procedures, and final approval of the manuscript. All authors read and approved the final version of the manuscript.

Data availability statement

The datasets generated and analysed during the current study are available from the corresponding author upon reasonable request. Due to patient confidentiality and institutional policies, de-identified data can be shared with qualified researchers for academic and non-commercial purposes, subject to approval by the Institutional Ethics Committee of the participating institution.

Biography

Dr. Vadlamanu Usha Rani, MD, is an accomplished microbiologist with over 15 years of experience in diagnostic microbiology, antimicrobial resistance, and medical education. She earned her M.B.B.S. from Kakatiya Medical College, Warangal, where she was

Student's Journal of Health Research Africa
e-ISSN: 2709-9997, p-ISSN: 3006-1059
Vol.6 No. 6 (2025): June 2025 Issue
https://doi.org/10.51168/sjhrafrica.v6i6.1919
Original Article

awarded University Distinctions in Pharmacology and Forensic Medicine. She subsequently completed her M.D. in Microbiology at Osmania Medical College, Hyderabad, ranking second in the NTR University final examinations. Dr. Usha Rani has held faculty positions at Kakatiya Medical College and currently serves as Associate Professor in the Department of Microbiology at Government Medical College, Narsampet. Her academic interests focus on infection control, antimicrobial stewardship, and the immunological diagnosis of infectious diseases. She has conducted pioneering research on doripenem susceptibility in Gram-negative bacilli and the early diagnosis of dengue infections using serological and molecular methods, for which she received the prestigious Bhaskaran Award. She has authored peer-reviewed publications in the Journal of Biomedical and Pharmaceutical Research, with her papers indexed in EMBASE, DOAJ, SCOPUS, and Index Copernicus. She has presented her work at numerous national conferences and contributed to advancing evidence-based practices in microbiology. In addition to her research contributions, Dr. Usha Rani has been actively involved in teaching undergraduate and postgraduate students and has delivered training on hospital epidemiology and PCR techniques. She is committed to improving laboratory practices and infection control protocols and continues to mentor young clinicians and microbiologists. Her ORCID is https://orcid.org/0009-0000-4865-0932.

Dr. Pambi Sujatha, MD (Community Medicine), is a committed medical educator and public health professional who completed her MBBS from Prathima Institute of Medical Sciences, Karimnagar, and pursued her postgraduate training (MD) in Community Medicine at Kakatiya Medical College, Warangal. She began her academic career as an Assistant Professor in the Department of Community Medicine at Kakatiya Medical College, Warangal, where she served from 2019 to 2024, actively engaging in undergraduate and postgraduate teaching, mentoring, and community health programs. Since 2024, she has been serving as an Associate Professor in Community Medicine at Government Medical College, Narsampet, where she continues to contribute to academic development and public health practice. Dr. Sujatha has authored numerous research publications in reputed peer-reviewed journals indexed in SCOPUS, DOAJ, and EMBASE, reflecting her commitment to advancing knowledge in epidemiology, maternal and child health, and non-communicable disease prevention. She has received awards in various sports and games competitions at institutional and intercollegiate levels, demonstrating her holistic approach to professional and personal growth. Known for her excellent teaching capabilities, she is highly regarded for delivering clear, engaging lectures and practical training sessions, effectively guiding undergraduate and postgraduate students in Community Medicine. Her ORCiD is https://orcid.org/0009-0002-1602-7809

Dr. Chandrasekhar B.M., MS (Orthopaedics), is a highly accomplished orthopaedic surgeon with over 30 years of distinguished clinical experience and a steadfast commitment to medical education. He began his academic career as an Assistant Professor in the Department of Orthopaedics at Government Medical College, Suryapet, serving from 2019 to 2024, where he played a pivotal role in training undergraduate and postgraduate students and enhancing the department's clinical standards. Since June 2024, he has been working as an Associate Professor at Government Medical College, Khammam, where he continues to mentor future orthopaedic surgeons with dedication and insight. Dr. Chandrasekhar is renowned for his exceptional surgical skills, encompassing complex trauma fixation, joint replacement, arthroscopic procedures, and deformity correction, all performed with meticulous precision and an evidence-based approach. He has authored several publications in reputed peer-reviewed journals, with many of his research articles indexed in leading international databases such as Scopus, EMBASE, and the Directory of Open Access Journals (DOAJ), reflecting the scientific rigor, credibility, and impact of his scholarly work in advancing the field of orthopaedics. Highly regarded for his clear, methodical teaching style and his ability to instill both confidence and competence in his trainees, Dr. Chandrasekhar embodies professionalism, integrity, and excellence in every facet of his clinical and academic endeavors.

Dr. Keshava Rao Bolloju, MS, is a distinguished orthopaedic surgeon currently serving as an Associate Professor in the Department of Orthopaedics at Government Medical College, Narsampet, Telangana. He also functions as a National External Assessor for the National Quality Assurance Standards (NQAS) Programme, contributing to the quality assessment and accreditation of government hospitals across India. Previously, he held the position of Assistant Professor at MGM Hospital and Kakatiya Medical College, Warangal, where he contributed extensively to both clinical services and academic mentorship. Dr. Bolloju earned his Bachelor of Medicine and Bachelor of Surgery

Student's Journal of Health Research Africa
e-ISSN: 2709-9997, p-ISSN: 3006-1059
Vol.6 No. 6 (2025): June 2025 Issue
https://doi.org/10.51168/sjhrafrica.v6i6.1919
Original Article

(M.B.B.S.) from Kakatiya Medical College, Hanumakonda, Warangal (2000–2005), followed by a Master of Surgery (M.S.) in Orthopaedics from the Prathima Institute of Medical Sciences, Karimnagar, Telangana (2012–2015). With over a decade of dedicated service spanning primary, secondary, and tertiary healthcare settings, he has demonstrated exceptional proficiency as a treating physician, medical officer, and programme officer for national health initiatives throughout the erstwhile state of Andhra Pradesh and present-day Telangana. Renowned for his surgical acumen, Dr. Bolloju possesses advanced expertise in managing complex trauma, performing joint reconstructions, and employing Ilizarov's technique of external fixation for limb salvage and correction of severe deformities. His surgical repertoire encompasses the management of polytrauma, open fractures, neglected injuries, and deformity corrections, delivered with a patient-centred approach that emphasises functional recovery and quality of life. He has been instrumental in training and mentoring undergraduate and postgraduate medical students, integrating evidence-based practices into orthopaedic education. His primary research interests include trauma care protocols, general orthopaedics, and innovations in external fixation techniques. Dr. Bolloju has organised numerous outreach health camps, delivering specialised care to individuals with disabilities and facilitating the issuance of disability certificates to support their social and economic empowerment. He has authored and co-authored multiple research publications in reputable indexed journals, including EMBASE, SCOPUS, and DOAJ, reflecting his sustained commitment to advancing orthopaedic science and improving patient care. His ORCID is https://orcid.org/0009-0007-9372-8955.

References

1. Kaye KS, Engemann JJ, Mozaffari E, Carmeli Y. Reference group choice and antibiotic resistance outcomes in studies of antimicrobial resistance. Ann Intern Med. 2004 May 18;140(10):823-30. https://doi.org/10.7326/0003-4819-140-10-200405180-00010 PMid:15148067
2. Klein EY, Sun L, Smith DL, Laxminarayan R. The changing epidemiology of methicillin-resistant Staphylococcus aureus in the United States: a national observational study. Am J Epidemiol. 2013 Sep 1;177(7):666-74. https://doi.org/10.1093/aje/kws273 PMid:23449778
3. Broex ECJ, Van Asselt ADI, Bruggeman CA, Van Tiel FH. Surgical site infections: how high are the costs? J Hosp Infect. 2009 Jul;72(3):193-201. https://doi.org/10.1016/j.jhin.2009.03.020 PMid:19482375
4. David MZ, Siegel J, Lowy FD, Zervos MJ, Clemenston JS. Methicillin-resistant Staphylococcus aureus infections in healthcare settings. N Engl J Med. 2012 Apr;367(7):640-9. https://doi.org/10.1056/NEJMra1201533 PMid:23738546 PMCid:PMC3777557
5. Chambers HF, Deleo FR. Waves of resistance: Staphylococcus aureus in the antibiotic era. Nat Rev Microbiol. 2009 Sep;7(9):629-41. PMID:19680247.https://doi.org/10.1038/nrmicro2200 PMid:19680247 PMCid:PMC2871281
6. Zetola N, Francis JS, Nuermberger EL, Bishai WR. Community-acquired meticillin-resistant Staphylococcus aureus: an emerging threat. Lancet Infect Dis. 2005 May;5(5):275-86.https://doi.org/10.1016/S1473-3099(05)70112-2 PMid:15854883
7. David MZ, Daum RS. Community-associated methicillin-resistant Staphylococcus aureus: epidemiology and clinical consequences of an emerging epidemic. Clin Microbiol Rev. 2010 Jul;23(3):616-87. https://doi.org/10.1128/CMR.00081-09 PMid:20610826 PMCid:PMC2901661
8. Otter JA, French GL. Community-associated methicillin-resistant Staphylococcus aureus strains as a cause of healthcare-associated infection. J Hosp Infect. 2011 Jan;79(3):189-93. https://doi.org/10.1016/j.jhin.2011.05.014 PMid:21764173
9. Liu C, Bayer A, Cosgrove SE, Daum RS, Fridkin SK, Gorwitz RJ, et al. Clinical practice guidelines by the Infectious Diseases Society of America for the treatment of methicillin-resistant Staphylococcus aureus infections in adults and children. Clin Infect Dis. 2011 Feb 1;52(3):e18-55. https://doi.org/10.1093/cid/ciq146 PMid:21208910
10. Fridkin SK, Hageman JC, Morrison M, Sanza LT, Como-Sabetti K, Jernigan JA, et al. Methicillin-resistant Staphylococcus aureus disease in three communities. N Engl J Med. 2005 Apr 7;352(14):1436-44. https://doi.org/10.1056/NEJMoa043252 PMid:15814879

Student's Journal of Health Research Africa
e-ISSN: 2709-9997, p-ISSN: 3006-1059
Vol.6 No. 6 (2025): June 2025 Issue
https://doi.org/10.51168/sjhrafrica.v6i6.1919
Original Article

11. Gosselin RC, Corkill JE, Anson JG, Woodford N, Livermore DM. Antibiotic resistance among Gram-positive cocci: surveillance findings in orthopaedic infections. J Chemother. 2011 Aug;23(4):230-6. PMID:21787269. doi:10.1179/joc.2011.23.4.230.
12. Prematunge C, MacDougall C, Johnstone J, Adomako K, Lam F, Robertson J, Garber G. Varying estimates of methicillin-resistant Staphylococcus aureus (MRSA) burden and transmission in the hospital setting: a systematic review. BMC Infect Dis. 2016 Apr 18;16:150. PMID:27086788. doi:10.1186/s12879-016-1470-5.
13. Popovich KJ, Weinstein RA, Hota B. Are community-associated methicillin-resistant Staphylococcus aureus (MRSA) strains replacing traditional nosocomial MRSA strains? Clin Infect Dis. 2008 May 1;46(6):787-94. https://doi.org/10.1086/527394 PMid:18230044
14. Kock R, Becker K, Cookson B, van Gemert-Pijnen JE, Harbarth S, Kluytmans J, et al. Methicillin-resistant Staphylococcus aureus (MRSA): burden of disease and control challenges in Europe. Euro Surveill. 2010 Nov 11;15(41):19688. https://doi.org/10.2807/ese.15.41.19688-en PMid:20961515
15. Lipsky BA, Berendt AR, Cornia PB, Pile JC, Peters EJG, Armstrong DG, et al. 2012 Infectious Diseases Society of America clinical practice guideline for the diagnosis and treatment of diabetic foot infections. Clin Infect Dis. 2012 Jun;54(12):e132-73. https://doi.org/10.1093/cid/cis346 PMid:22619242

PUBLISHER DETAILS

Student's Journal of Health Research (SJHR)
(ISSN 2709-9997) Online
(ISSN 3006-1059) Print
Category: Non-Governmental & Non-profit Organization
Email: studentsjournal2020@gmail.com
WhatsApp: +256 775 434 261
Location: Scholar's Summit Nakigalala, P. O. Box 701432, Entebbe Uganda, East Africa