

Prevalence and Risk Factors Associated with *Staphylococcus Aureus* in Wound Infection Among Patient Attending Selected Hospitals in Kano Central, Kano Nigeria

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Abstract

The present study investigated the prevalence of Staphylococcus aureus among patients with wound infections attending selected hospitals in Kano State. A swab samples of wound were collected from patients with wound infection attending Dawakin Kudu General Hospital, Murtala Muhammad Specialist Hospital and National Orthopedic Hospital Dala, all in Kano. Identification of Staphylococcus aureus and Methicillin resistant Staphylococcus aureus was conducted using standard microbiological techniques. Questionnaire was administered to obtained demographic and other related information. The findings revealed that 77 (35.48%) of the 217 wound samples examined were positive for S. aureus. Based on the age of the participants, the highest prevalence of S. aureus was observed among patients aged 31–45 years (15.21%), followed by those aged 16–30 years (8.76%), whereas the lowest prevalence was found among patients aged over 45 years (5.53%). Regarding sex, male patients accounted for a higher proportion of S. aureus isolates (20.74%) compared with female patients (14.75%). Married participants had the highest prevalence of S. aureus (21.20%), followed by single (10.60%) and widowed (3.69%) participants. Participants with secondary education recorded the highest prevalence of S. aureus (17.51%), followed by those with primary education (7.83%), while respondents with Islamiyya and tertiary education had lower prevalence. Although employed participants recorded the highest prevalence (21.20%), followed by unemployed (10.14%) and retired participants (4.15%). Urban residents had a higher prevalence of S. aureus (22.58%) than rural residents (12.90%), while MRSA was also more common among urban participants (1.38% versus 0.46%). It is concluded that prevalence of S. aureus was influenced by several risk factors.

Keywords: Prevalence, Risk factors, Methicillin resistance *Staphylococcus aureus*, wound

Introduction

Wound infection remains one of the most common complications associated with injuries, surgical procedures, burns, diabetic ulcers, and traumatic wounds. It continues to be a major public health concern worldwide because it delays wound healing, prolongs hospital stay,

increases treatment costs, and contributes significantly to patient morbidity and mortality (WHO, 2025). A wound becomes infected when pathogenic microorganisms invade damaged tissues, multiply, and trigger an inflammatory response that interferes with the normal healing process (Reddy and Shabnum, 2024). The risk of infection depends on several factors, including the type and severity of the wound, the patient's immune status, hygiene practices, and the quality of healthcare services received (WHO, 2023). Among the microorganisms implicated in wound infections, *Staphylococcus aureus* is recognized as one of the most important bacterial pathogens. It is a Gram-positive, facultative anaerobic coccus that commonly colonizes the skin and anterior nares of healthy individuals. Although it forms part of the normal human flora, *S. aureus* becomes pathogenic when it gains access to damaged skin or underlying tissues through wounds, burns, surgical incisions, or invasive medical procedures. The organism possesses numerous virulence factors, including toxins, enzymes, adhesins, and immune-evasion mechanisms that enable it to establish infection, destroy host tissues, and resist immune defences. Consequently, *S. aureus* is responsible for a wide spectrum of diseases ranging from superficial skin infections to severe invasive diseases such as septicemia, osteomyelitis, endocarditis, and pneumonia (WHO, 2023).

The increasing prevalence of methicillin-resistant *Staphylococcus aureus* (MRSA) has further complicated the management of wound infections worldwide. MRSA strains are resistant to methicillin and several other β -lactam antibiotics, thereby limiting treatment options and increasing the risk of treatment failure (Azzam *et al.*, 2025). Antimicrobial resistance has become one of the greatest global health threats of the twenty-first century, largely driven by the inappropriate use and misuse of antibiotics in human medicine, veterinary practice, and agriculture. According to the World Health Organization, antimicrobial resistance contributes substantially to illness, death, and healthcare expenditure globally, highlighting the urgent need for continuous surveillance of resistant bacterial pathogens such as *S. Aureus* (Sahle and Merid, 2024). In Nigeria, wound infections remain a significant cause of prolonged hospitalization and increased healthcare costs. Previous microbiological studies conducted in Nigerian hospitals have consistently identified *S. aureus* as one of the predominant bacterial agents isolated from infected wounds (Naji and Hassan, 2023). Surveillance studies have also shown increasing antimicrobial resistance among wound pathogens, emphasizing the need for rational antibiotic use and continuous microbiological monitoring. Despite advances in infection prevention and control, wound infections continue to place a considerable burden on healthcare facilities due to poor hygiene, delayed presentation, self-medication, and indiscriminate antibiotic use (Bowler *et al.*, 2018). Determining the prevalence of *Staphylococcus aureus* among patients with wound infections attending selected hospitals in Kano is therefore essential for several reasons. It will provide valuable epidemiological data on the burden of the organism, assist clinicians in selecting appropriate empirical antibiotic therapy, support antimicrobial stewardship programmes, strengthen infection prevention and control strategies, and contribute to public health surveillance. The findings may also serve as baseline information for future research on antimicrobial resistance, particularly methicillin-resistant *Staphylococcus aureus* (MRSA), within Kano State and Nigeria as a whole. Therefore, this study seeks to determine the prevalence of *Staphylococcus aureus* among patients with wound infections attending selected hospitals in Kano.

Materials and Methods

Study Area

The study was conducted at three selected hospitals in Kano central senatorial district namely; Dawakin Kudu general hospital on 12°00'07.9"N 8°35'31.1"E and Murtala Muhammad Specialist Hospital on 11°59'56"N 8°31'19"E and National Orthopedics Hospital Dala on

12.0202°N, 8.5031°E. Kano State has a total area of 20,131 km² (7,777sqm) and projected population of 17.5 million as of 2026 (WPR, 2026).

Ethical clearance

An ethical approval was obtained from Kano state Hospital management board. After signing of an informed consent form prepared in accordance with the declaration of Helsinki (McGuinness *et al.*, 2017).

Sample Size

These are patients with burns and Wounds hospital in the study area, and the out patients that report to the dressing centers and the laboratory for wound swab microscopy culture and sensitivity (MCS). The number of the samples used in the study was calculated based on the standard epidemiological formula for the determination of minimum samples size adopted from Garba *et al.* (2025).

$$N = \frac{Z^2 pq}{D^2}$$

N = Desired sample size, S = Standard deviation at 95%, Z = 1.96 Confidence interval, D = 0.05, mean deviation, n = 95%

P = estimated/expected prevalence from previous study in area, P = previous prevalence = 14% = 0.14 (Hagenimana and Fidele, 2022)

From the above formula $N = \frac{Z^2 pq}{D^2}$ P = 0.14,

$$Q = 1 - P = 1 - 0.14 = 0.86$$

$$N = \frac{(1.96)^2 (0.14 \times 0.86)}{(0.05)^2}$$

$$N = \frac{3.843 \times 0.1204}{0.0025}$$

$$N = \frac{0.4627}{0.0025} = 185.08$$

Therefore, a total of 200 samples will be used for this study.

Sample collection

A swab samples were collected from patients with wound infection attending Dawakin Kudu General Hospital, Murtala Muhammad Specialist Hospital and National Orthopedic Hospital Dala, all in Kano. Pus samples from the wounds were collected using two sterile cotton swabs after cleaning the wound with sterile normal saline. Samples were collected preferably from depth of the wound under aseptic precaution and care was taken to avoid contamination from normal flora of skin. Samples collected were transferred immediately to the laboratory of Microbiology, Aliko Dangote University of Science and Technology for isolation and identification of *S. aureus* (Garba *et al.*, 2025)

Questionnaire Administration

A total of two hundred (200) simple structured questionnaires were designed using close ended questions to provide information about the socio-demographic factors of participants and predisposing factors to wound infections. Informed consents were obtained from all participants before inclusion (Salisu *et al.*, 2018).

Isolation and Identification of *S. aureus*

Isolation of *S. aureus* was conducted according to the method described by Garba *et al.* (2025). Wound samples were inoculated on to the surface of solidified nutrients agar and incubated at 37°C for 24 hours. Colonies formed were sub-cultured on Mannitol salt agar and re-incubated at 37°C for 24 hours until a pure colony was obtained. The isolates were identified by

conventional microbiological methods: Gram staining and Biochemical tests (DNase test, Catalase test, Coagulase test and Mannitol fermentation test) and molecular characterization as described by Cheesbrough (2012) and Idris *et al.* (2018)

Results

Prevalence of *S. aureus* in relation to Hospitals

The study investigated the prevalence of *Staphylococcus aureus* and Methicillin-Resistant *Staphylococcus aureus* (MRSA) across three hospitals: Dawakin Kudu General Hospital (DKDG), Murtala Muhammad Specialist Hospital (MMSH), and National Orthopedic Hospital Dala (NOHD). The findings revealed that out of 217 total samples tested, *S. aureus* was detected in 77 (35.48%) samples as in (Table 1). Hospital-specific analysis showed that patients attending Murtala Muhammad Specialist Hospital (MMSH) had the highest prevalence of *S. aureus* infection, with 35 (16.13%) positive isolates, followed by Nuhu Bamalli Orthopaedic Hospital (NOHD), which recorded 23 (10.59%) positive isolates, while Dala Orthopaedic and Kidney Disease Hospital (DKDG) recorded the lowest prevalence, with 19 (8.76%) positive isolates.

Table 1: Prevalence of *Staphylococcus aureus* in relation to Hospitals

Hospitals	Sample Tested (%)	Positive of <i>S. aureus</i> (%)	Negative for <i>S. aureus</i> (%)
DKDG	73(33.64)	19(8.75)	54(24.89)
MMSH	90(41.47)	35(16.13)	55(25.34)
NOHD	54(24.88)	23(10.59)	22(10.14)
Total	217(100)	77(35.48)	131(60.36)
P-value			0.290

Key; DKDG – Dawakin Kudu General Hospital, MMSH – Murtala Muhammad Specialist Hospital, NOHD – National Orthopedic Hospital Dala, there is no significant difference in the prevalence of both *S. aureus* in the selected hospital at p-value < 0.05.

Distribution of *S. aureus* and MRSA in relation to Demographic Factors

The distribution of *S. aureus* and MRSA in relation to demographic factors is presented in Table 2. Based on the age of the participants, the highest prevalence of *S. aureus* was observed among patients aged 31–45 years (15.21%), followed by those aged 16–30 years (8.76%), whereas the lowest prevalence was found among patients aged over 45 years (5.53%). Regarding sex, male patients accounted for a higher proportion of *S. aureus* isolates (20.74%) compared with female patients (14.75%). Married participants had the highest prevalence of *S. aureus* (21.20%), followed by single (10.60%) and widowed (3.69%) participants. Participants with secondary education recorded the highest prevalence of *S. aureus* (17.51%), followed by those with primary education (7.83%), while respondents with Islamiyya and tertiary education had lower prevalence. Although employed participants recorded the highest prevalence (21.20%), followed by unemployed (10.14%) and retired participants (4.15%). Urban residents had a higher prevalence of *S. aureus* (22.58%) than rural residents (12.90%), while MRSA was also more common among urban participants (1.38% versus 0.46%).

Table 2: Prevalence of *S. aureus* and MRSA in relation to Demographic Factors

Factors	Categories	Sample Tested	Prevalence of <i>S. aureus</i>	Prevalence of MRSA	X ² (p-value)
Age	0 – 15	35(16.13)	13(5.99)	0(0%)	0.226
	16 – 30	47(21.66)	19(8.76)	2(0.92)	
	31 – 45	79(36.41)	33(15.21)	1(0.46)	
	> 45	56(25.81)	12(5.53)	1(0.46)	
	Total	217(100)	77(35.48)	4(1.84)	
Sex	Male	119(54.84)	45(20.74)	3(1.38)	0.525
	Female	98(45.16)	32(14.75)	1(0.46)	
	Total	217(100)	77(35.48)	4(1.84)	
Marital Status	Married	103(47.47)	46(21.20)	2(0.92)	0.097
	Single	86(39.63)	23(10.60)	1(0.46)	
	Widow	28(12.90)	08(3.69)	1(0.46)	
	Total	217(100)	77(35.48)	4(1.84)	
Education	Islamiyya	23(10.60)	11(5.07)	0(0%)	0.017*
	Primary	56(25.81)	17(7.83)	2(0.92)	
	Secondary	78(35.94)	38(17.51)	2(0.92)	
	Tertiary	60(27.65)	11(5.07)	0(0%)	
	Total	217(100)	77(35.48)	4(1.84)	
	Occupation	Unemployed	63(29.03)	22(10.14)	
Employed	123(56.68)	46(21.20)	2(0.92)		
Retired	31(14.29)	09(4.15)	1(0.46)		
Total	217(100)	77(35.48)	4(1.84)		
Types of Residence	Urban	121(55.76)	49(22.58)	3(1.38)	0.164
	Rural	96(44.24)	28(12.90)	1(0.46)	
	Total	217(100)	77(35.48)	4(1.84)	

Key: MRSA – Methicillin Resistant *Staphylococcus aureus*, X² – Chi – square test

Distribution of *S. aureus* and MRSA in relation to Risk Factors

Distribution of *Staphylococcus aureus* and Methicillin Resistance *S. aureus* in relation to Risk factors in table 3 indicated that hospitalization status showed a statistically significant association with the occurrence of *S. aureus* and MRSA ($p = 0.028$). Although outpatients accounted for the largest number of *S. aureus* isolates (35; 16.13%). Participants who had previously undergone laboratory culture recorded a higher prevalence of *S. aureus* (18.89%) and all four MRSA isolates than those without a previous culture history). Patients with a history of antibiotic use had a higher proportion of *S. aureus* isolates (28.11%) than those without previous antibiotic use (7.37%), and all MRSA isolates were recovered from antibiotic users

Table 3: Prevalence of *S. aureus* and MRSA in relation to Risk Factors

Factors	Categories	Sample Tested (%)	Prevalence of <i>S. aureus</i> (%)	Prevalence of MRSA (%)	X ² (p-value)
Hospitalization	Out patients	131(60.37)	35(16.13)	1(0.46)	0.028*
	Hospitalized	57(26.27)	28(12.90)	2(0.92)	
	Discharge Recently	29(13.36)	14(6.45)	1(0.46)	
	Total	217(100)	77(35.48)	4(1.84)	
History of Laboratory Culture	Yes	148(68.20)	41(18.89)	4(1.84)	0.005*
	No	69(31.80)	36(16.59)	0	
	Total	217(100)	77(35.48)	4(1.84)	
History of Antibiotic Usage	On used	187(86.18)	61(28.11)	4(1.84)	0.077
	Not Used	30(13.82)	16(7.37)	0	
	Total	217(100)	77(35.48)	4(1.84)	

Key words; MRSA – Methicillin Resistant *Staphylococcus aureus*

Discussion

The present study investigated the prevalence of *Staphylococcus aureus* among patients with wound infections attending selected hospitals in Kano State. The findings revealed that 77 (35.48%) of the 217 wound samples examined were positive for *S. aureus*. This demonstrates that *S. aureus* remains one of the predominant bacterial pathogens responsible for wound infections in the study area. The high prevalence may be attributed to the organism's ability to colonize the skin and mucous membranes of healthy individuals and subsequently invade damaged tissues through traumatic wounds, burns, surgical incisions, and chronic ulcers. The organism possesses several virulence factors, including protein A, coagulase, hemolysins, and biofilm-forming ability, which enhance its pathogenicity and persistence in wound tissues (Tong *et al.*, 2015; WHO, 2023). The overall prevalence of 35.48% observed in this study is comparable with findings from several studies conducted in Nigeria and other developing countries, where *S. aureus* has consistently been reported as one of the leading bacterial causes of wound infections. Anekwe (2026) reported that *S. aureus* was among the predominant bacterial isolates recovered from infected wounds in a tertiary healthcare facility in southeastern Nigeria. Similarly, a systematic review by Okwor *et al.* (2018) identified *S. aureus* as one of the most frequently isolated pathogens from wound infections across Nigeria. These similarities suggest that *S. aureus* continues to be a major public health concern because of its widespread distribution, ease of transmission, and increasing antimicrobial resistance. The relatively high prevalence recorded in this study may also reflect poor wound hygiene, delayed hospital presentation, self-medication with antibiotics, inadequate infection prevention and control practices, and the widespread misuse of antimicrobial agents within the community. These factors encourage bacterial survival, colonization, and the emergence of resistant strains of *S. aureus*, particularly methicillin-resistant *Staphylococcus aureus* (MRSA). The World Health Organization (2023) has identified antimicrobial resistance in *S. aureus* as one of the major global public health challenges requiring continuous surveillance and improved antimicrobial stewardship. With respect to age, the highest prevalence of *S. aureus* was observed among patients aged 31–45 years (15.21%), followed by those aged 16–30 years (8.76%), whereas the lowest prevalence was found among patients aged over 45 years (5.53%). MRSA was detected mainly among patients aged 16–30, 31–45, and over 45 years, while no

MRSA isolate was recovered from patients aged 0–15 years. However, there was no statistically significant association between age and the occurrence of *S. aureus* or MRSA ($p = 0.226$). This finding suggests that wound infection due to *S. aureus* can occur across all age groups. The relatively higher prevalence among adults of working age may be related to increased occupational exposure, road traffic accidents, manual labour, and surgical interventions, which predispose individuals to wounds and subsequent bacterial infection. Similar observations have been reported in studies from Nigeria and other African countries, where adults constituted the majority of patients with wound infections (Anekwe, 2026; Okwor *et al.*, 2018).

Regarding sex, male patients accounted for a higher proportion of *S. aureus* isolates (20.74%) compared with female patients (14.75%). Similarly, MRSA was more frequently isolated from males (1.38%) than females (0.46%). However, this difference was not statistically significant ($p = 0.525$). The higher prevalence among males may reflect their greater involvement in occupations and activities associated with trauma, occupational injuries, and road traffic accidents. Similar male predominance has been reported in previous studies of wound infections, although sex is often not an independent predictor after adjustment for other factors. Marital status also showed no statistically significant association with *S. aureus* or MRSA prevalence ($p = 0.097$). Married participants had the highest prevalence of *S. aureus* (21.20%), followed by single (10.60%) and widowed (3.69%) participants. This pattern is likely influenced by the larger number of married participants enrolled in the study rather than marital status itself affecting susceptibility to infection. Most epidemiological studies have similarly found that marital status is not an independent risk factor for wound infection. Similarly, place of residence showed no statistically significant association with infection ($p = 0.164$). Urban residents had a higher prevalence of *S. aureus* (22.58%) than rural residents (12.90%), while MRSA was also more common among urban participants (1.38% versus 0.46%). The higher prevalence among urban residents may be explained by increased hospital attendance, higher population density, and greater opportunities for exposure to healthcare-associated pathogens. However, because the difference was not statistically significant, residence alone cannot be considered an independent predictor of *S. aureus* infection in this study.

Hospitalization status showed a statistically significant association with the occurrence of *S. aureus* and MRSA ($p = 0.028$). Although outpatients accounted for the largest number of *S. aureus* isolates (35; 16.13%) because they constituted the largest study group, hospitalized patients and those recently discharged also had substantial numbers of infections, including MRSA isolates. This finding suggests that exposure to healthcare environments may increase the risk of acquiring *S. aureus*, particularly antibiotic-resistant strains. Hospitals provide opportunities for cross-transmission through contact with contaminated surfaces, medical devices, healthcare workers, and other infected or colonized patients. In addition, prolonged hospital stays, invasive procedures, surgical interventions, and frequent wound dressing increase the likelihood of bacterial colonization and infection. Similar findings have been reported by the World Health Organization (2023), which recognizes *Staphylococcus aureus*, especially MRSA, as a major cause of healthcare-associated infections worldwide. Likewise, Tong *et al.* (2015) reported that hospitalization remains one of the strongest predictors of *S. aureus* infection because healthcare settings facilitate the transmission of virulent and antimicrobial-resistant strains. History of laboratory culture was also significantly associated with the prevalence of *S. aureus* and MRSA ($p = 0.005$). Participants who had previously undergone laboratory culture recorded a higher prevalence of *S. aureus* (18.89%) and all four MRSA isolates than those without a previous culture history. This finding may reflect the fact that patients requiring microbiological investigation often present with persistent, recurrent, severe, or non-healing wounds, making them more likely to harbour pathogenic bacteria, including resistant strains. It may also indicate that clinicians are more likely to request

laboratory culture for patients suspected of having complicated wound infections. Similar observations have been reported in studies showing that chronic wounds and recurrent infections frequently require microbiological investigation because they are more likely to contain multidrug-resistant organisms (Lipsky *et al.*, 2020). Overall, the findings indicate that healthcare-related exposures play an important role in the epidemiology of *Staphylococcus aureus* wound infections in the study area. The significant associations observed with hospitalization and previous laboratory culture emphasize the importance of strict infection prevention and control practices, early microbiological diagnosis, regular surveillance, and antimicrobial stewardship programmes in reducing the burden of *S. aureus* and MRSA infections. Hospitals should strengthen hand hygiene compliance, environmental cleaning, aseptic wound care techniques, and routine culture with antimicrobial susceptibility testing to ensure prompt diagnosis and appropriate treatment of wound infections.

Conclusion

The findings of this study demonstrate that *Staphylococcus aureus* remains a major cause of wound infection among patients attending the selected hospitals in Kano, with an overall prevalence of 35.48%. Although the prevalence varied across hospitals and demographic groups, most demographic characteristics, including age, sex, marital status, occupation, and place of residence, were not significantly associated with the occurrence of *S. aureus* infection. Educational status was the only demographic factor that showed a statistically significant association, suggesting that differences in health literacy, hygiene practices, and healthcare-seeking behaviour may influence the risk of infection. Among the clinical risk factors evaluated, hospitalization and history of laboratory culture were significantly associated with the prevalence of *S. aureus* and MRSA, indicating that healthcare-related exposure and the presence of persistent or complicated wounds contribute to the occurrence of these infections. It is recommended that health-care facilities should routinely perform antimicrobial susceptibility testing on *Staphylococcus aureus* isolates to guide antibiotic selection and reduce the indiscriminate use of broad-spectrum antibiotics.

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