Prevalence and antibiotic resistance profile of *Staphylococcus aureus* nasal carriage among a school community

Mahendra Gunawardane* and Nadeeka Kumudu Kumari

Department of Microbiology, Faculty of Science, University of Kelaniya, Kelaniya, Sri Lanka

*Corresponding author: mahendra@kln.ac.lk

ORCID ID: https://orcid.org/0000-0003-4980-8476

Received: 23.04.2026 Revised: 04.05.2026 Accepted: 06.05.2026 Online: 15.05.2026

Abstract Nasal carriage of *Staphylococcus aureus* plays a key role in the transmission of this opportunistic pathogen within communities and in the development of endogenous infections. This study aimed to determine the prevalence of nasal carriage of *S. aureus* and to assess the antibiotic resistance profile of isolates among school students in Sri Lanka. Nasal swabs were collected from 50 students and cultured on Baird–Parker medium. Identification was performed using colony morphology, Gram staining, and standard biochemical tests. Antibiotic susceptibility testing was carried out using the disc diffusion method in accordance with Clinical and Laboratory Standards Institute guidelines. *S. aureus* was isolated from 35 students, indicating a prevalence of 70%. All isolates were sensitive to vancomycin, streptomycin, ciprofloxacin, erythromycin, and clindamycin, while all isolates were resistant to ampicillin. Resistance to penicillin was observed in 45.7% of isolates. This study provides one of the few reports on *S. aureus* nasal carriage among school-aged adolescents in Sri Lanka and demonstrates a high prevalence with notable resistance to β-lactam antibiotics, highlighting the need for continuous community-level surveillance and prudent antimicrobial use.

Keywords: Antibiotic resistance, Antimicrobial susceptibility, Community surveillance, Nasal carriage, School students, Staphylococcus aureus

Introduction

Staphylococcus aureus is a Gram-positive bacterium that commonly colonizes human skin and the anterior nares as part of the normal microbiota. Despite its commensal nature, it is an opportunistic pathogen capable of causing a wide range of infections, including skin and soft tissue infections, bacteremia, pneumonia, and endocarditis (Tong et al., 2015). Nasal carriage of *S. aureus* is a well-recognized risk factor for both endogenous infections and transmission within community and healthcare settings (Wertheim et al., 2005).

School-based populations represent environments characterized by close interpersonal contact, shared facilities, and variable hygiene practices, all of which may facilitate the transmission of colonizing microorganisms. Adolescents, in particular, often engage in frequent physical interactions that increase opportunities for bacterial spread. In addition, the emergence of antibiotic-resistant *S. aureus* strains, particularly those resistant to β-lactam antibiotics, has increased the public health importance of monitoring carriage patterns in community settings (Chambers & DeLeo, 2009). Although nasal carriage of *S. aureus* has been extensively studied in various populations worldwide, data on school-based adolescent populations in Sri Lanka remain limited. Understanding the prevalence and antibiotic susceptibility patterns of *S. aureus* in such communities is important for identifying potential reservoirs of infection and guiding public health interventions.

Therefore, the present study was conducted to determine the prevalence of nasal carriage of *S. aureus* among school students and to evaluate the antibiotic susceptibility profile of the recovered isolates.

Materials and Methods

Study design and population

A cross-sectional study was conducted among 50 school students aged 15–16 years from a mixed-gender school community in Sri Lanka. Participation was voluntary, and only apparently healthy students were included in the study.

Sample collection

Nasal swab samples were collected aseptically from the anterior nares of each participant using sterile cotton swabs. The samples were transported immediately to the laboratory and processed within 2 hours of collection.

Isolation of S. aureus

Samples were inoculated onto Baird–Parker agar and incubated at 37 °C for 24–48 hours. Presumptive *S. aureus* colonies were identified based on characteristic morphology, including black, shiny colonies with clear zones.

Identification of isolates

Presumptive isolates were confirmed using Gram staining and standard biochemical tests, including catalase and coagulase tests (slide and tube methods using rabbit plasma). Additional tests included glucose fermentation, oxidation–fermentation (O/F), nitrate reduction, urease activity, Voges–Proskauer reaction, arginine dihydrolase activity, and gelatin hydrolysis. Isolates showing characteristic reactions were considered confirmed as *S. aureus*.

Antibiotic susceptibility testing

Antibiotic susceptibility testing was performed using the disc diffusion method. The antibiotics tested were vancomycin, streptomycin, ciprofloxacin, erythromycin, clindamycin, penicillin, and ampicillin. Zone diameters were measured after incubation and interpreted as sensitive or resistant according to Clinical and Laboratory Standards Institute (CLSI) guidelines (CLSI, 2023).

Data analysis

Data were analyzed using descriptive statistics and expressed as percentages.

Results

Prevalence of S. aureus

Out of the 50 nasal swab samples collected from school students, 35 samples were positive for *S. aureus*, indicating a prevalence of 70%.

Identification of isolates

All isolates showed characteristic colony morphology on Baird–Parker agar and were confirmed as *S. aureus* by Gram staining and biochemical tests. The isolates were Gram-positive cocci arranged in clusters and showed positive reactions for catalase and coagulase tests, along with characteristic results in the additional biochemical tests performed.

Antibiotic susceptibility profile

The antibiotic susceptibility pattern of the 35 confirmed *S. aureus* isolates is summarized in Table 1.

Table 1. Antibiotic susceptibility profile of *Staphylococcus aureus* isolates (n = 35)

Antibiotic	Sensitive n (%)	Resistant n (%)
Ampicillin	0 (0%)	35 (100%)
Ciprofloxacin	35 (100%)	0 (0%)
Clindamycin	35 (100%)	0 (0%)
Erythromycin	35 (100%)	0 (0%)
Penicillin	19 (54.3%)	16 (45.7%)
Streptomycin	35 (100%)	0 (0%)
Vancomycin	35 (100%)	0 (0%)

Note: The disc diffusion method was used for antibiotic susceptibility testing. Results were interpreted according to Clinical and Laboratory Standards Institute (CLSI) guidelines (CLSI, 2023).

All isolates (100%) were sensitive to vancomycin, streptomycin, ciprofloxacin, erythromycin, and clindamycin. In contrast, all isolates (100%) were resistant to ampicillin. Resistance to penicillin was observed in 45.7% of the isolates.

Discussion

The present study demonstrated a relatively high prevalence (70%) of nasal carriage of *S. aureus* among school students aged 15–16 years. This prevalence is higher than the commonly reported range of 20–40% in the general population (Kluytmans et al., 1997; Wertheim et al., 2005). The elevated carriage rate observed in this study may be associated with the close interpersonal contact, shared facilities, and hygiene practices characteristic of school environments, which facilitate the transmission of colonizing microorganisms.

Previous studies have reported considerable variability in *S. aureus* carriage rates depending on population characteristics, study settings, and methodologies (Kluytmans et al., 1997). Among schoolchildren, studies from South Asia have demonstrated notable nasal colonization, including reports of methicillin-resistant *S. aureus* (MRSA) carriage (Singh et al., 2018). In Sri Lanka, carriage rates have shown heterogeneity across age groups, with lower prevalence reported among older adults and moderate levels among preschool children (Handapangoda et al., 2024; Iqbal et al., 2024). These findings indicate that nasal carriage of *S. aureus* is highly context-dependent and influenced by factors such as age, population density, and interpersonal contact patterns.

The antibiotic susceptibility profile observed in this study showed that all isolates were sensitive to vancomycin, streptomycin, ciprofloxacin, erythromycin, and clindamycin, suggesting that these antibiotics remain effective against community-associated *S. aureus* strains. In contrast, all isolates were resistant to ampicillin, which is consistent with the widespread presence of β-lactamase–producing *S. aureus* strains (Chambers & DeLeo, 2009). Resistance to penicillin was observed in 45.7% of isolates, indicating variability in resistance patterns within the study population.

Similar resistance patterns have been reported in regional studies, where substantial resistance to β-lactam antibiotics has been documented among *S. aureus* isolates from community populations (Akter et al., 2024; Handapangoda et al., 2024; Iqbal et al., 2024;

Singh et al., 2018; Taqveem et al., 2024). These findings highlight the influence of antibiotic usage practices and selection pressure on resistance patterns in community settings.

The observed differences in prevalence and antibiotic resistance across studies may be attributed to variations in antibiotic use, prescribing practices, hygiene conditions, and microbiological methodologies. Environmental and behavioral factors, including close contact among students and shared facilities, likely contribute to the transmission dynamics in school settings.

Limitations

This study has several limitations. The sample size was relatively small and limited to a single school, which may affect the generalizability of the findings. In addition, molecular characterization of isolates was not performed; therefore, specific resistance mechanisms, including the presence of methicillin-resistant *S. aureus* (MRSA), could not be determined. Furthermore, the cross-sectional design and single-time sampling limit the ability to assess temporal variations in carriage status.

Conclusion

This study demonstrates a high prevalence of nasal carriage of *S. aureus* among school students, along with notable resistance to commonly used β-lactam antibiotics. Although susceptibility to several non–β-lactam antibiotics remains high, the findings highlight the importance of continuous surveillance of *S. aureus* carriage in community settings. These results underscore the need for prudent antibiotic use and the implementation of appropriate public health strategies to limit the spread of resistant strains.

Acknowledgements

The authors would like to acknowledge the technical assistance, encouragement, and guidance provided by Ramya Priyadarshani and Shyama Dissanayaka during the experimental work.

Funding

This research received no external funding.

Ethical approval

Ethical approval for the study was obtained from the Ethics Review Committee of the Asian Institute of Technology and Business Management (AITBM), Sri Lanka. Written informed consent was obtained from parents or legal guardians, and assent was obtained from participating students. All data were anonymized to ensure confidentiality.

Conflicts of interest

The authors declare that there are no conflicts of interest

Author contributions

M.G.: Conceptualization, Methodology, Formal analysis, Writing (original draft), Writing (review & editing)
N.K.K.: Investigation, Data curation, Validation, Reviewing the manuscript

References

Akter, S., Barua, H., Rana, E. A., Ferdous Reza, T., & Chowdhury, S. (2024). Prevalence of nasal carriage of *Staphylococcus aureus* among medical and veterinary students. *IAHS Medical Journal, 7*(2), 73–77.

Chambers, H. F., & DeLeo, F. R. (2009). Waves of resistance: *Staphylococcus aureus* in the antibiotic era. *Nature Reviews Microbiology, 7*(9), 629–641. https://doi.org/10.1038/nrmicro2200

Clinical and Laboratory Standards Institute. (2023). *Performance standards for antimicrobial susceptibility testing* (33rd ed., CLSI supplement M100). CLSI.

Handapangoda, H. M. N. P., Ruwansiri, L. P. A. L. P., Dissanayake, U. P. R. U., Kudagammana, S. T., Dissanayake, B. N., &

Liyanapathirana, L. V. C. (2024). Nasal colonisation of *Staphylococcus aureus* and *Streptococcus pneumoniae* in preschool children attending selected immunisation clinics, Kandy, Sri Lanka. *Sri Lanka Journal of Infectious Diseases, 14*(Suppl), S7. https://doi.org/10.4038/sljid.v14i5.8786

Iqbal, I., Sabri, Z., Menike, D., Dissanayake, R., Ekanayake, A., & Liyanapathirana, V. (2024). Nasal colonization with *Staphylococcus aureus* and methicillin-resistant *Staphylococcus aureus* among community-dwelling older adults with comorbidities in Central Sri Lanka. *Access Microbiology, 6*, 000724.v3. https://doi.org/10.1099/acmi.0.000724.v3

Kluytmans, J., van Belkum, A., & Verbrugh, H. (1997). Nasal carriage of *Staphylococcus aureus*: Epidemiology, underlying mechanisms, and associated risks. *Clinical Microbiology Reviews, 10*(3), 505–520. https://doi.org/10.1128/CMR.10.3.505

Singh, A. K., Agarwal, L., Kumar, A., Sengupta, C., & Singh, R. P. (2018). Prevalence of nasal colonization of methicillin-resistant *Staphylococcus aureus* among schoolchildren of Barabanki district, Uttar Pradesh, India. *Journal of Family Medicine and Primary Care, 7*(1), 162–166. https://doi.org/10.4103/jfmpc.jfmpc_345_16

Taqveem, A., Rasool, M. H., Aslam, B., Mujahid, F., Ibrar, A., Ejaz, H., et al. (2024). Methicillin-resistant *Staphylococcus aureus* among students: Nasal carriage rate, contributing factors, and antimicrobial susceptibility. *Medicina, 60*(10), 1590.

Tong, S. Y. C., Davis, J. S., Eichenberger, E., Holland, T. L., & Fowler, V. G., Jr. (2015). *Staphylococcus aureus* infections: Epidemiology, pathophysiology, clinical manifestations, and management. *Clinical Microbiology Reviews, 28*(3), 603–661. https://doi.org/10.1128/CMR.00134-14

Wertheim, H. F. L., Melles, D. C., Vos, M. C., van Leeuwen, W., van Belkum, A., Verbrugh, H. A., & Nouwen, J. L. (2005). The role of nasal carriage in *Staphylococcus aureus* infections. *The Lancet Infectious Diseases, 5*(12), 751–762. https://doi.org/10.1016/S1473-3099(05)70295-4

.