Ecological Risk and Security Research (2025) Volume 3 Issue 2
doi: 10.59429/ersr.v3i2.12214

RESEARCH ARTICLE

Methicillin-Resistant *Staphylococcus aureus* Contamination of Mobile Phones and Associated Hygiene Practices

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ABSTRACT

Background: Methicillin-resistant *Staphylococcus aureus* (MRSA) is a significant cause of antimicrobial-resistant infections. Mobile phones, due to frequent handling and inadequate cleaning, may act as reservoirs for pathogenic bacteria.

Objective: To detect *Staphylococcus aureus* and MRSA on mobile phones and assess antimicrobial susceptibility patterns and associated usage habits.

Methods: A cross-sectional study was conducted from January to March 2022 at Prime Asia University, Dhaka. Forty mobile phone swabs were collected from students, security staff, faculty staff, canteen staff, and cleaning staff. *S. aureus* was identified using standard microbiological methods, MRSA was detected phenotypically, and antibiotic susceptibility was assessed by disc diffusion.

Results: *Staphylococcus aureus* was isolated from all samples, with 87.5% showing methicillin resistance. High resistance was observed to cephalosporins and vancomycin, while amikacin (92.5%) and ciprofloxacin (85%) showed high susceptibility. MRSA prevalence was highest among security and cleaning staff and was associated with poor phone hygiene practices.

Conclusion: Mobile phones can act as reservoirs for MRSA. Regular disinfection and good hygiene practices are essential to reduce microbial transmission.

Keywords: MRSA; Staphylococcus aureus; Mobile phones; Antibiotic resistance; Hygiene

1. Introduction

Methicillin-resistant Staphylococcus aureus (MRSA) remains one of the most significant causes of antimicrobial-resistant infections worldwide and represents a growing public health challenge. *Staphylococcus aureus* is a Gram-positive bacterium that commonly colonizes the skin and mucosal surfaces

ARTICLE INFO
Received: 12 June 2025 |Accepted: 7 July 2025 | Available online: 25 August 2025

CITATION
Mim, M. A.; Isa, I. B.; Habiba, M. U.; Rimu, A. J.. Methicillin-Resistant Staphylococcus aureus Contamination of Mobile Phones and Associated Hygiene Practices. *Ecological Risk and Security Research* 2025; 3(2): 12214.doi: 10.59429/ersr.v3i2.12214

of humans and animals[1]. Although often present as a commensal organism, *S. aureus* is capable of causing a wide spectrum of infections ranging from superficial skin infections to life-threatening conditions such as pneumonia, septicemia, and endocarditis. The emergence and global dissemination of MRSA have substantially limited therapeutic options and increased morbidity, mortality, and healthcare costs[2].

In recent years, increasing attention has been directed toward non-clinical reservoirs of pathogenic bacteria that may contribute to community-associated transmission. Mobile phones have become indispensable personal devices and are handled repeatedly throughout the day[3]. Their frequent contact with hands, face, and various environmental surfaces, combined with infrequent cleaning and disinfection, makes them potential fomites for microbial contamination. Several studies have demonstrated that mobile phones can harbor a wide range of microorganisms, including antibiotic-resistant bacteria, and may facilitate indirect transmission between individuals and environments[4].

The risk of contamination is further amplified by common user behaviors, such as using mobile phones in toilets, during food preparation, or within healthcare and public spaces. These practices increase the likelihood of exposure to pathogenic microorganisms and subsequent cross-contamination[5]. In particular, the presence of MRSA on mobile phones is of concern due to its ability to persist on inanimate surfaces and its resistance to multiple antimicrobial agents, thereby posing a threat not only to individual users but also to the broader community[6].

Despite growing evidence that mobile phones act as reservoirs for pathogenic bacteria, data on the prevalence of *S. aureus* and MRSA on mobile phones, along with their antimicrobial resistance patterns and associated user habits, remain limited in many settings. Comprehensive evaluation of these factors is essential for understanding the role of mobile phones in the transmission of antimicrobial-resistant organisms and for developing effective preventive strategies[7].

The study aimed to identify Staphylococcus aureus from mobile phones, evaluate antibiotic susceptibility patterns, detect MRSA using phenotypic methods, and assess associations between user habits and bacterial contamination.

2. Materials and methods

2.1. Study Design and Setting

A cross-sectional study was conducted at the Microbiology Laboratory of Prime Asia University, Dhaka, Bangladesh, from January to March 2022. The study was designed to investigate the presence of *Staphylococcus aureus*, including methicillin-resistant *Staphylococcus aureus* (MRSA), on mobile phones used by different occupational groups within the university environment.

2.2. Study Population and Sample Distribution

A total of 40 mobile phone swab samples were collected from five distinct participant categories: students, security staff, faculty staff, canteen staff, and cleaning staff. Eight samples were collected from each category to ensure equal representation across groups. The distribution of samples is presented in **Table 1**.

Table 1. Distribution of Mobile Phone Swab Samples by Participant Category

Sample Category	Number of Samples (n)	Sample Type
Students	08	Mobile phone swabs
Security staff	08	
Faculty staff	08	
Canteen staff	08	
Cleaning staff	08	
Total	40	

Participation was voluntary, and informed consent was obtained from all participants prior to sample collection.

2.3. Sample Collection Procedure

Mobile phone samples were collected using sterile cotton swabs moistened with sterile normal saline. The swabs were gently rubbed over frequently touched surfaces of each mobile phone, including the screen, keypad or touchscreen area, and outer casing. After collection, swabs were placed into sterile transport tubes and immediately transported to the microbiology laboratory for processing, typically within one hour of collection.

Figure 1. Swab Sampling of Mobile Phone Surface for Microbiological Analysis

2.4. Microbiological Culture and Isolation

Each swab sample was inoculated onto Mannitol Salt Agar (MSA) and Blood Agar plates using standard streaking techniques. The inoculated plates were incubated aerobically at 37°C for 24–48 hours.

Plates were examined for colony morphology, mannitol fermentation, pigmentation, and hemolytic activity. Presumptive *Staphylococcus* colonies were subcultured to obtain pure isolates.

2.5. Identification of *Staphylococcus aureus*

Isolates were identified based on Gram staining, which demonstrated Gram-positive cocci arranged in clusters. Biochemical confirmation was performed using catalase and coagulase tests. Isolates that were catalase-positive and coagulase-positive were confirmed as *Staphylococcus aureus*.

2.6. Detection of Methicillin-Resistant *Staphylococcus aureus*

Phenotypic detection of methicillin resistance was performed using the oxacillin disc diffusion method on Mueller–Hinton agar. Following incubation at 37°C for 24 hours, zone diameters were measured and interpreted according to standard laboratory guidelines. Isolates showing resistance to oxacillin were classified as MRSA.

2.7. Antibiotic Susceptibility Testing

Antimicrobial susceptibility testing was carried out using the Kirby–Bauer disc diffusion method on Mueller–Hinton agar. The antibiotics tested included oxacillin, tetracycline, ciprofloxacin, azithromycin, amikacin, cotrimoxazole, ceftriaxone, ceftazidime, colistin, and vancomycin. Results were interpreted as susceptible, intermediate, or resistant based on standard clinical laboratory criteria.

2.8. Data Collection on Mobile Phone Usage Habits

A structured questionnaire was used to collect information on mobile phone usage habits, including frequency of phone cleaning, use of mobile phones in toilets, phone-sharing practices, use of protective phone covers, and hand hygiene practices. These data were analyzed descriptively to explore possible associations with bacterial contamination.

2.9. Data Analysis

Collected data were entered into a spreadsheet and analyzed descriptively. Results were expressed as frequencies and percentages to summarize the prevalence of *Staphylococcus aureus*, MRSA, and antibiotic resistance patterns among the different participant categories.

3. Results

Information on demographic characteristics and mobile phone usage habits was collected using a semi-structured questionnaire. The distribution of mobile phone usage behaviors across different participant categories is summarized in **Table 1**. Routine cleaning and disinfectant use were highest among faculty members, while cleaning staff and security personnel reported comparatively lower cleaning practices. Use of mobile phones in toilets was reported mainly by students and security staff. Touchscreen phones were predominantly used across all categories, except among cleaning staff, where equal use of touch and button phones was observed.

Table 2. Mobile Phone Usage Habits among Different Participant Categories

Category	Use in Toilet (%)	Routine Cleaning (%)	Phone Cover Use (%)	Phone Sharing (%)	Disinfectant Use (%)	Touch Phone (%)	Button Phone (%)
Students	38	75	75	50	87.5	100	0
Security staff	25	50	50	50	50	75	25

Category	Use in Toilet (%)	Routine Cleaning (%)	Phone Cover Use (%)	Phone Sharing (%)	Disinfectant Use (%)	Touch Phone (%)	Button Phone (%)
Faculty staff	0	100	100	50	100	100	0
Canteen staff	0	66	68	34	66	100	0
Cleaning staff	0	45	50	50	50	50	50

Table 2. (*Continued*)

The phenotypic and biochemical characteristics of the isolates are presented in **Table 2**. All isolates showed typical morphological and biochemical features consistent with *Staphylococcus aureus*, confirming successful identification using standard microbiological methods.

Table 3. Phenotypic and Biochemical Characteristics of *Staphylococcus aureus* Isolates

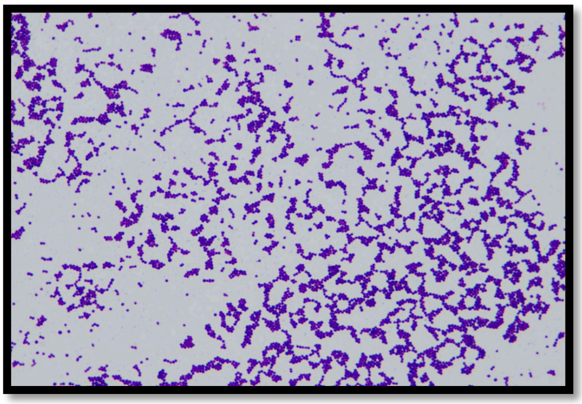
Test	Result
Gram staining	Gram-positive cocci in clusters
Catalase test	Positive
Coagulase test	Positive
Oxidase test	Negative
Blood agar	Beta-hemolytic
Mannitol Salt Agar	Yellow colonies

MSA Agar (yellow colony)

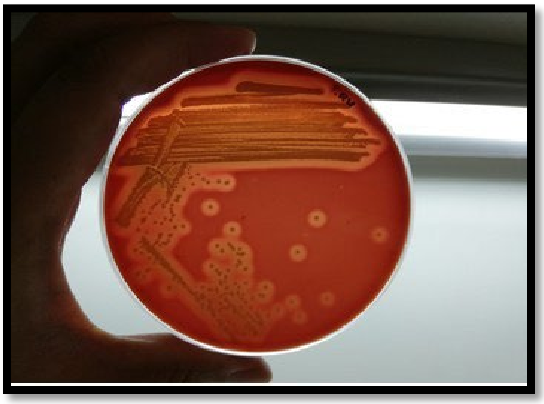
Oxidase Test (-)

c. Catalase Test (+)

Coagulase Test (+)



Gram's Staining (x100)



Blood Agar (Beta haemolysis)

Figure 2. Biochemical test results for *S. aureus* identification

Carbohydrate fermentation patterns of the *S. aureus* isolates are shown in Table 3. The isolates demonstrated fermentation of multiple carbohydrates, including mannitol and dextrose, further supporting the identification of *S. aureus*.

Table 4. Carbohydrate Fermentation Profile of *Staphylococcus aureus* Isolates

Carbohydrate	Acid Production
Lactose	Positive
Ribose	Positive
Galactose	Positive
Mannitol	Positive
Dextrose	Positive
Sorbitol	Positive
Casein	Positive
Salicin	Negative
Xylose	Negative
Arabinose	Negative
Raffinose	Negative

Figure 3. Carbohydrate Fermentation assay

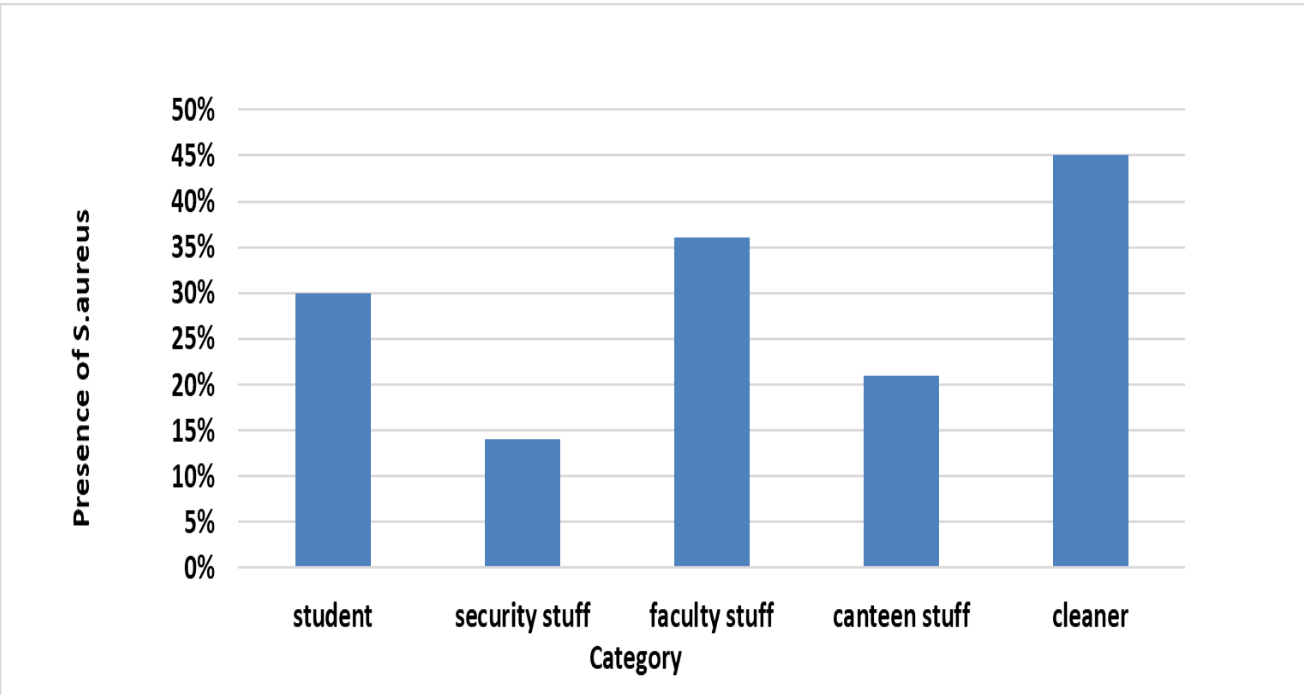


Figure 4. Presence of *S.aureus* in different category

The antibiotic susceptibility profile of the isolates, determined by the disc diffusion method, is presented in Table 4. A high level of resistance to oxacillin was observed, indicating a substantial prevalence of MRSA. Resistance to cephalosporins and vancomycin was also notably high. In contrast, amikacin and ciprofloxacin demonstrated the highest susceptibility rates.

Table 5. Antibiotic Susceptibility Pattern of *Staphylococcus aureus* Isolates (n = 40)

Antibiotic	Class	Sensitive (%)	Intermediate (%)	Resistant (%)
Oxacillin	β-lactam	12.5	–	87.5
Tetracycline	Tetracycline	70	20	10
Ciprofloxacin	Fluoroquinolone	85	12.5	2.5
Azithromycin	Macrolide	62.5	7.5	30
Amikacin	Aminoglycoside	92.5	7.5	0
Cotrimoxazole	Sulfonamide	77.5	17.5	5
Colistin	Polymyxin	0	5	95
Ceftriaxone	Cephalosporin	0	5	95
Ceftazidime	Cephalosporin	0	2.5	97.5
Vancomycin	Glycopeptide	22.5	–	77.5

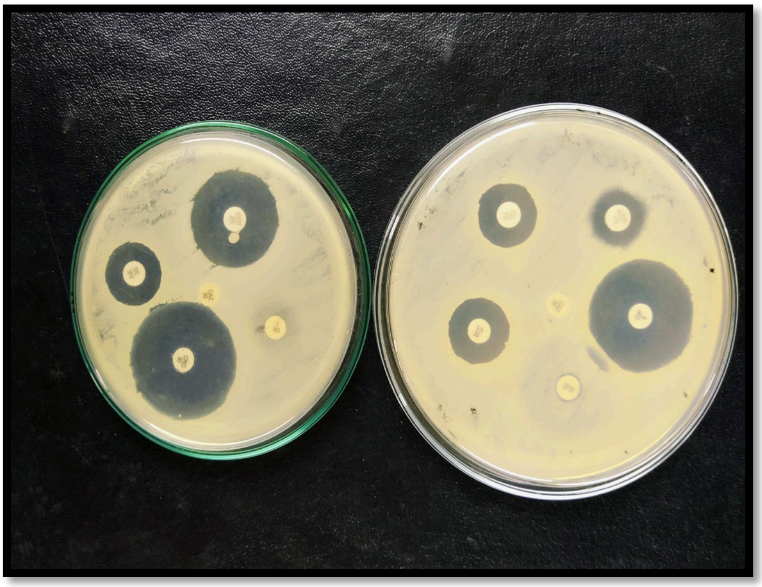


Figure 5. Antibiotic disk diffusion Test against *S.aureus*

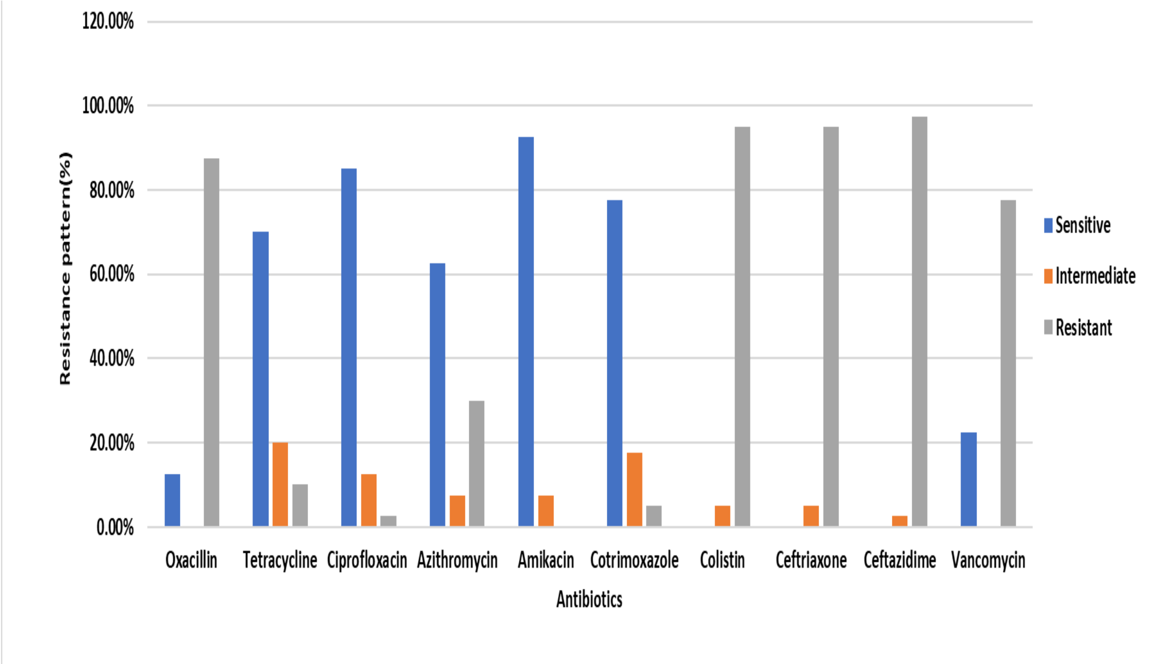


Figure 6. Antibiotic SUSCEPTIBILITY PATTERN OF *S.AUREUS*

The proportion of MRSA and methicillin-sensitive *S. aureus* (MSSA) across participant categories is shown in Table 5. MRSA prevalence was highest among security staff, followed by cleaning staff. Students, faculty, and canteen staff showed similar MRSA proportions. These findings indicate widespread contamination of mobile phones with MRSA across different occupational groups.

Table 6. Distribution of MRSA and MSSA among Different Participant Categories

Category	MRSA (%)	MSSA (%)
Students	62.5	37.5
Security staff	100	0
Faculty staff	62.5	37.5
Canteen staff	62.5	37.5
Cleaning staff	87.5	12.5

4. Discussion

The present study demonstrated a high level of mobile phone contamination with *Staphylococcus aureus*, as the organism was isolated from all collected samples. The recovery of *S. aureus* from 100% of mobile phones highlights the role of these frequently handled personal devices as potential reservoirs of pathogenic bacteria. Similar high contamination rates have been reported in previous investigations, indicating that mobile phones provide favorable conditions for bacterial survival and transmission due to constant hand contact and infrequent cleaning practices.

The distribution of contamination varied across participant categories, with the highest prevalence of MRSA observed among security staff and cleaning staff. This finding may be attributed to increased environmental exposure, frequent handling of potentially contaminated surfaces, and comparatively lower adherence to routine phone disinfection practices observed in these groups. In contrast, faculty members reported higher rates of routine cleaning and disinfectant use, which may explain the relatively lower proportion of MRSA in this group. The association between mobile phone usage habits—such as use in toilets, phone sharing, and irregular cleaning—and bacterial contamination underscores the importance of behavioral factors in microbial transmission[8].

Phenotypic and biochemical characterization confirmed that all isolates exhibited typical characteristics of *Staphylococcus aureus*, including Gram-positive cocci in clusters, catalase and coagulase positivity, and beta-hemolysis on blood agar. Approximately 90% of the isolates showed beta-hemolytic activity, indicating their pathogenic potential. The consistency of these findings with standard identification criteria reinforces the reliability of the microbiological methods used in this study[9].

Carbohydrate fermentation profiling further supported the identification of *S. aureus*, as the isolates fermented key carbohydrates such as mannitol, dextrose, and sorbitol while failing to ferment others such as salicin and raffinose. These metabolic patterns are characteristic of *S. aureus* and have been widely documented in similar studies. The uniformity of fermentation results across isolates suggests the predominance of a typical *S. aureus* biochemical profile among mobile phone contaminants[10].

The antibiotic susceptibility pattern observed in this study is of particular concern. A very high resistance to oxacillin (87.5%) was detected, indicating a substantial prevalence of MRSA among the isolates. Resistance to cephalosporins was also markedly high, and a considerable proportion of isolates showed resistance to vancomycin, which is often regarded as a last-resort antibiotic. These findings are consistent with reports of increasing multidrug resistance among community-associated *S. aureus* isolates and raise concerns regarding the potential role of mobile phones in disseminating antimicrobial-resistant strains[11].

In contrast, high susceptibility to amikacin and ciprofloxacin was observed, suggesting that these agents may remain effective treatment options for *S. aureus* infections in similar settings. However, the presence of high resistance rates to multiple antibiotic classes emphasizes the need for cautious and rational use of antimicrobial agents to prevent further development of resistance[12].

The analysis of MRSA and methicillin-sensitive *S. aureus* (MSSA) distribution revealed that MRSA predominated across all participant categories, with the highest prevalence among security staff and cleaning staff. This widespread distribution indicates that MRSA contamination of mobile phones is not confined to a specific occupational group and may contribute to community-level transmission. Given the frequent handling of mobile phones and their close contact with the face and hands, contaminated devices may act as silent vectors for the spread of resistant bacteria.

5. Conclusion

This study demonstrates that mobile phones can serve as reservoirs for methicillin-resistant *Staphylococcus aureus*, posing a potential public health risk. Poor hygiene practices and phone use in contaminating environments may facilitate cross-contamination. Regular disinfection of mobile phones and adherence to good personal hygiene practices are essential to reduce the transmission of antimicrobial-resistant bacteria.

Conflict of interest

The authors declare no conflict of interest

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