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Antibiotic susceptibility patterns of *S. aureus* isolates from community-acquired infections

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Abstract

What fraction of skin and soft tissue infections seen in walk-in clinics across tropical Latin America are driven by drug-resistant *S. aureus*? This research addressed that question by examining antibiotic susceptibility profiles of 284 *S. aureus* isolates recovered from patients with community-acquired infections in Quibdó, Colombia, between March 2022 and February 2023. Susceptibility testing followed the Kirby-Bauer disk diffusion method, and minimum inhibitory concentrations were determined by broth microdilution for key agents. Phenotypic methicillin resistance was confirmed by cefoxitin disk screening and corroborated with *mecA* gene detection by PCR. Among 284 isolates, 38.7% were classified as methicillin-resistant *S. aureus* (MRSA). Resistance to penicillin reached 76.1%, while erythromycin resistance stood at 57.2%. Vancomycin and linezolid retained high activity at 98.7% and 96.3% susceptibility, respectively. Multidrug resistance was detected in 29.6% of isolates. These findings point to a worrying reservoir of resistant organisms outside hospital settings in the Chocó region.

Keywords: Antibiotic susceptibility, *S. aureus*, community-acquired infections, methicillin-resistant *S. aureus*, disk diffusion, broth microdilution, drug resistance, tropical microbiology, empiric therapy, antimicrobial stewardship

Introduction

What happens when first-line antibiotics stop working against one of the most common human pathogens? *S. aureus* ranks among the leading causes of skin and soft tissue infections worldwide, and its capacity to acquire resistance determinants has turned it into a persistent public health challenge ^[1]. Community-acquired methicillin-resistant *S. aureus* (CA-MRSA) was once thought to be confined to hospital wards, but it has established itself firmly in outpatient settings across both temperate and tropical zones ^[2].

In Latin America, national surveillance networks have reported MRSA prevalence figures ranging from 25% to 50%, yet these estimates lean heavily on data from tertiary hospitals in capital cities ^[3]. Colombia's Pacific lowlands combine high humidity, limited sanitation, and restricted access to culture-guided therapy—conditions that may promote the selection of resistant strains ^[4]. Quibdó, capital of the Chocó department, serves a largely Afro-Colombian population with some of the country's highest poverty indices ^[5].

Earlier work from Bogotá and Medellín documented clonal spread of the USA300 Latin American Variant among CA-MRSA isolates ^[6]. Whether the same lineage circulates in Chocó was unknown. Patterns of co-resistance to macrolides, fluoroquinolones, and aminoglycosides influence empiric treatment choices for cellulitis and wound infections ^[7]. This research set out to determine antibiotic susceptibility profiles of *S. aureus* isolates from community-acquired infections in Quibdó over twelve months, characterise seasonal trends in MRSA proportions, and assess multidrug resistance frequency ^[8].

Reagents and Chemicals

Mueller-Hinton agar (Oxoid, Basingstoke, UK) and Mueller-Hinton broth (BD Difco, Sparks, MD, USA) were used for disk diffusion and broth microdilution assays. Antibiotic disks were sourced from HiMedia Laboratories (Mumbai, India) and included oxacillin (1 µg), cefoxitin (30 µg), vancomycin (30 µg), linezolid (30 µg), erythromycin (15 µg), clindamycin (2 µg), ciprofloxacin (5 µg), penicillin (10 U), tetracycline (30 µg),

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trimethoprim-sulfamethoxazole (1.25/23.75 µg), and gentamicin (10 µg). For *mecA* confirmation, primers were synthesised by Integrated DNA Technologies (Coralville, IA, USA), and GoTaq Green Master Mix was from Promega (Madison, WI, USA). DNA extraction kits (DNeasy Blood and Tissue Kit) were from Qiagen (Hilden, Germany). *S. aureus* ATCC 25923 and ATCC 43300 served as quality-control strains.

Materials and Methods

Materials

Clinical specimens were collected from 284 patients presenting with community-acquired skin and soft tissue infections at four primary health posts in Quibdó, Chocó, Colombia, between March 2022 and February 2023. Eligible patients had not been hospitalised within the preceding 90 days. Wound swabs, abscess aspirates, and skin lesion specimens were transported in Amies charcoal medium within two hours to the microbiology laboratory at the Instituto de Biodiversidad del Chocó. Isolates were identified through Gram staining, catalase reaction, tube coagulase testing, and mannitol salt agar fermentation. Each isolate was stored in tryptic soy broth with 15% glycerol at -80°C .

Methods

Susceptibility was assessed by Kirby-Bauer disk diffusion on Mueller-Hinton agar following CLSI 2023 guidelines [9]. Methicillin resistance was screened with a 30 µg cefoxitin disk; isolates with zones ≤ 21 mm were classified as MRSA [10]. MICs for vancomycin and linezolid were confirmed by broth microdilution. Molecular confirmation used conventional PCR targeting *mecA* [11]. Multidrug resistance was defined as non-susceptibility to at least one agent in three or more classes [12]. Chi-square tests compared MRSA and MSSA groups ($p < 0.05$). Monthly MRSA proportions were plotted for seasonal variation. Analyses used R version 4.3.1.

Quality Control

ATCC 25923 and ATCC 43300 were tested alongside clinical isolates on each testing day. Zone diameters for controls fell within CLSI-acceptable ranges across all days; any deviating batch was repeated. Broth microdilution included quality-control wells per plate. PCR included positive (ATCC 43300) and no-template negative controls per reaction set. Temperature logs were reviewed daily ($35 \pm 1^{\circ}\text{C}$).

Results

Table 1: Antibiotic susceptibility profile of 284 *S. aureus* isolates from community-acquired infections, Quibdó, Colombia (March 2022 – February 2023)

Antibiotic	S (%)	I (%)	R (%)	MIC ₅₀	MIC ₉₀
Vancomycin	98.7	0.0	1.3	1	2
Linezolid	96.3	1.4	2.3	1	2
Gentamicin	87.3	2.1	10.6	≤ 1	4
TMP-SMX	82.5	3.2	14.3	≤ 0.5	2
Tetracycline	78.1	4.6	17.3	≤ 1	8
Clindamycin	71.4	5.3	23.3	0.25	≥ 4
Oxacillin	61.2	0.0	38.8	≤ 0.25	≥ 4
Ciprofloxacin	53.6	8.1	38.3	1	≥ 8
Erythromycin	42.8	6.7	50.5	1	≥ 8
Penicillin	23.9	0.0	76.1	≤ 0.06	≥ 2

S = susceptible; I = intermediate; R = resistant; TMP-SMX = trimethoprim-sulfamethoxazole; MIC in µg/mL.

Among 284 isolates, 110 (38.7%) were phenotypically MRSA by cefoxitin screening, and 107 carried *mecA* (97.3% confirmation). Penicillin resistance was the most common at 76.1%, followed by erythromycin at 50.5%. Vancomycin and linezolid remained active against nearly all isolates.

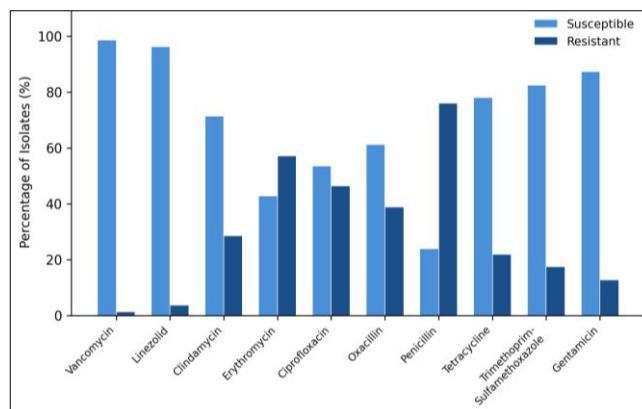


Fig 1: Susceptible and resistant proportions for ten antibiotics tested against 284 *S. aureus* isolates by disk diffusion

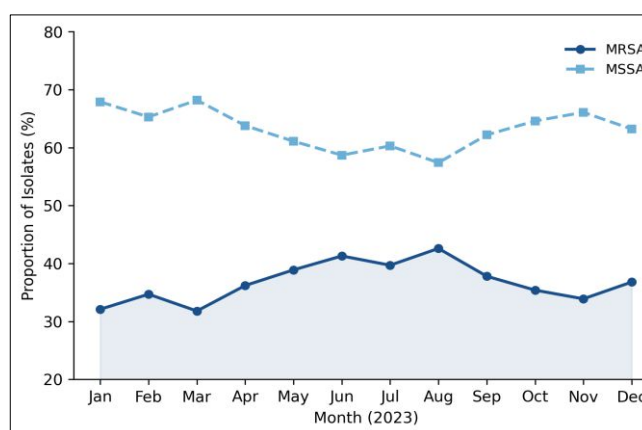


Fig 2: Monthly proportions of MRSA and MSSA among *S. aureus* isolates during the twelve-month collection period

A visible rise in MRSA proportion appeared between June and August, coinciding with the peak rainy season. August registered the highest MRSA share at 42.6%. MRSA isolates displayed significantly higher resistance to all tested agents compared with MSSA (all $p < 0.05$). Multidrug resistance was present in 84 isolates (29.6%) and was more frequent among MRSA (52.7%) than MSSA (15.5%; $p < 0.001$).

Discussion

The 38.7% MRSA prevalence in this community-based sample from Quibdó exceeds most published rates from Colombian urban centres. A multicentre review covering six Colombian hospitals reported an overall MRSA rate of 31.4%, dominated by nosocomial isolates [13]. Our data suggest that community reservoirs in Chocó harbour resistant clones at rates comparable to hospital settings elsewhere. Similar community-level MRSA rates of 35–42% have been documented in parts of Brazil and Peru [14]. The high co-resistance to erythromycin (78.2% among MRSA) makes macrolide-based empiric therapy unreliable in this population. Trimethoprim-sulfamethoxazole and

tetracycline maintained reasonable activity even against MRSA, echoing findings from other Latin American programmes ^[15]. The seasonal rise during the June-August rainy period warrants cautious interpretation—higher humidity may aggravate skin maceration and insect bites, both of which increase staphylococcal entry portals.

Conclusion

This research provides the first systematic snapshot of antibiotic susceptibility among community *S. aureus* isolates in Quibdó, Colombia. Nearly four in ten isolates were methicillin-resistant, and roughly a third met multidrug resistance criteria. Vancomycin and linezolid remain dependable, while trimethoprim-sulfamethoxazole and tetracycline offer practical outpatient alternatives. Local prescribing guidelines should be updated, and periodic surveillance cycles should be instituted. Future whole-genome sequencing of representative MRSA isolates would connect Chocó data to the broader Latin American molecular epidemiology picture ^[16].

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