

# Tracking Methicillin-Resistant *Staphylococcus aureus* among Community Clinical Isolates: A Five-Year Study

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## ABSTRACT

**Background:** Methicillin-resistant *Staphylococcus aureus* (MRSA) continues to be a significant public health threat worldwide. We sought to track MRSA strains among community isolates over the past 5 years, and analyse their resistance to commonly reported oral staphylococcal antimicrobial agents over the same period, in comparison to methicillin-susceptible *S. aureus* (MSSA).

**Methods:** From January 2008 to December 2012, all eligible clinical specimens ( $n = 252,290$ ), including urinary (U;  $n = 237,551$ ); skin and soft tissue (SST;  $n = 6,760$ ), respiratory (Rsp;  $n = 3,985$ ), eye/ear/nasal (EEN;  $n = 3,223$ ), and sterile site specimens (S;  $n = 771$ ) were cultured on appropriate media for clinically relevant pathogens. *S. aureus* was identified as MSSA or MRSA by conventional methods and processed for antimicrobial susceptibility testing (AST) where warranted, as per CLSI guidelines. EEN isolates were excluded from AST. Resistance to nitrofurantoin (FM) and trimethoprim/sulfamethoxazole (SXT) was determined for U isolates; resistance to SXT, clindamycin (CC), and erythromycin (E) was determined for SST, Rsp, and S isolates, in accordance with CLSI guidelines. Only non-duplicate isolates were included in the analysis.

**Results:** MRSA was isolated from 0.07%, 0.09%, 0.07%, 0.09%, and 0.09% of eligible specimens, accounting for 7.2%, 10.3%, 7.9%, 11.4%, and 10.1% of *S. aureus* in Year 1 (Y1), Y2, Y3, Y4, and Y5, respectively. MRSA and MSSA ( $n = 209$ ; 2,019) were isolated from SST ( $n = 169$ ; 1,294), U ( $n = 22$ ; 288), EEN ( $n = 12$ ; 376), Rsp ( $n = 6$ ; 51), and S ( $n = 0$ ; 10), respectively. MRSA vs MSSA resistance rates for SXT, FM, CC, and E were 1.5 vs 1.7%, 4.5 vs 3.1%, 30.9 vs 17.9% ( $P < 0.001$ ), and 79.4 vs 22.6% ( $P < 0.001$ ), respectively. There was a trend among MRSA vs MSSA isolates for decreasing resistance rates against E observed from Y1 (MRSA, 93.3% vs MSSA, 26.2%) through Y5 (71.1% vs 19.3%), respectively.

**Conclusions:** Rates of MRSA isolation from clinical specimens remained relatively stable over the past five years among community isolates. There was a trend for declining resistance rates against E over the same period. MRSA strains are more likely to be resistant than MSSA strains against CC and E, while SXT continues to have good activity *in vitro* against community isolates of both MSSA and MRSA.

## INTRODUCTION

Methicillin-resistant *Staphylococcus aureus* (MRSA) continues to be a major public health concern worldwide. Dissemination of infections caused by these and other multidrug-resistant organisms has recently been described as a significant threat of global crisis proportions.<sup>1</sup> The emergence of MRSA in the community has added new challenges, contributing to changing epidemiology and resistance profiles.<sup>2-5</sup> Community-associated MRSA (CA-MRSA) has displaced once predominant healthcare-associated MRSA (HA-MRSA) lineages, adding to the blurring between HA- and CA-MRSA, which emphasizes the need for more precise tracking in hospital and community settings.<sup>6</sup>

We sought to track MRSA strains among our local community isolates over the past five years, and analyse their resistance to commonly reported oral staphylococcal antimicrobial agents over the same period, in comparison to methicillin-susceptible *S. aureus* (MSSA).

## METHODS

From January 1<sup>st</sup>, 2008 to December 31<sup>st</sup>, 2012, all clinical specimens submitted for culture at Alpha Laboratories, in which *S. aureus* was sought as part of the routine workup for clinically relevant pathogens, were included in the study ( $n = 252,290$ ). Surveillance specimens were excluded. Eligible specimens were cultured on appropriate media and included urinary (U;  $n = 237,551$ ); skin and soft tissue comprising skin, wound, abscess, lesion, and ulcer specimens (SST;  $n = 6,760$ ); respiratory specimens, mainly sputa (Rsp;  $n = 3,985$ ); eye, ear, and nasal swabs (EEN;  $n = 3,223$ ); and sterile site specimens comprising blood and sterile body fluids (S;  $n = 771$ ).

*S. aureus* was identified as MSSA or MRSA by conventional methods and processed for antimicrobial susceptibility testing where warranted, as per CLSI guidelines.<sup>7</sup> EEN isolates were excluded from antimicrobial susceptibility testing. Resistance to nitrofurantoin (FM) and trimethoprim/sulfamethoxazole (SXT) was determined for U isolates; resistance to SXT, clindamycin (CC), and erythromycin (E) was determined for SST, Rsp, and S isolates, in accordance with CLSI guidelines. Only non-duplicate isolates were included in the data analysis.

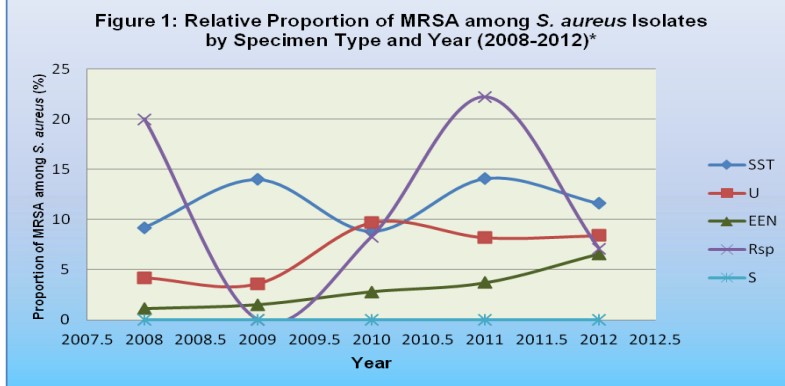
## RESULTS & DISCUSSION

**Five-Year MRSA vs MSSA Rates:** Of the 252,290 eligible specimens, MRSA was isolated from 0.07%, 0.09%, 0.07%, 0.09%, and 0.09% of eligible specimens in Year 1 (Y1), Y2, Y3, Y4, and Y5, respectively, reflecting a relatively stable rate of isolation from clinical samples. However, the proportion of MRSA among *S. aureus* fluctuated from 7.2% in Y1 to 10.3% in Y2, 7.9% in Y3, 11.4% in Y4, and 10.1% in Y5; fluctuations of the proportion of MRSA among *S. aureus* community isolates have similarly been reported over successive years in other North-American regions.<sup>8</sup> MRSA and MSSA ( $n = 209$ ; 2,019) were isolated from SST ( $n = 169$ ; 1,294), U ( $n = 22$ ; 288), EEN ( $n = 12$ ; 376), Rsp ( $n = 6$ ; 51), and S ( $n = 0$ ; 10), respectively. Compared to all other sites, the MRSA proportion was highest when isolated from SST. While the MRSA proportion from EEN and urinary sources showed a relative increase from 2008 through 2012 (Figure 1), the SST MRSA proportion fluctuated slightly from year to year, ultimately declining in 2012, consistent with recent findings in the U.S. that the rate of community-onset SST infections due to MRSA after peaking in 2006 has recently declined.<sup>9</sup>

Table 1: Antimicrobial Resistance Rates by Age Group

Age Group (yr) <sup>a</sup>	FM R/T (%R)		SXT R/T (%R)		E R/T (%R)		CC R/T (%R)	
	MSSA	MRSA	MSSA	MRSA	MSSA	MRSA	MSSA	MRSA
≤18	0/26 (0%)	0/0 (0%)	7/641 (1%)	0/40 (0%)	82/615 (13%)	28/40 (70%)	70/615 (11%)	14/40 (35%)
19 – 30	1/41 (2%)	0/1 (0%)	3/171 (2%)	0/21 (0%)	32/130 (25%)	17/20 (85%)	25/130 (19%)	1/20 (5%)
31 – 50	0/85 (0%)	0/5 (0%)	8/339 (2%)	1/55 (2%)	75/254 (30%)	42/50 (84%)	51/254 (20%)	12/50 (24%)
51 – 65	4/54 (7%)	1/4 (25%)	8/245 (3%)	1/37 (3%)	60/191 (31%)	27/33 (82%)	47/191 (25%)	11/33 (33%)
>65	4/82 (5%)	0/12 (0%)	2/247 (1%)	1/44 (2%)	56/165 (34%)	25/32 (78%)	49/165 (30%)	16/32 (50%)
Overall Resistance	9/288 (3.1%)	1/22 (4.5%)	28/1643 (1.7%)	3/197 (1.5%)	305/1355 (22.6%)	139/175 (79.4%)	242/1355 (17.9%)	54/175 (30.9%)

<sup>a</sup>% R, resistance rate (%); CC, clindamycin; E, erythromycin; FM, nitrofurantoin; R/T, number of isolates resistant / number of isolates tested; SXT, trimethoprim/sulfamethoxazole; yr, years.

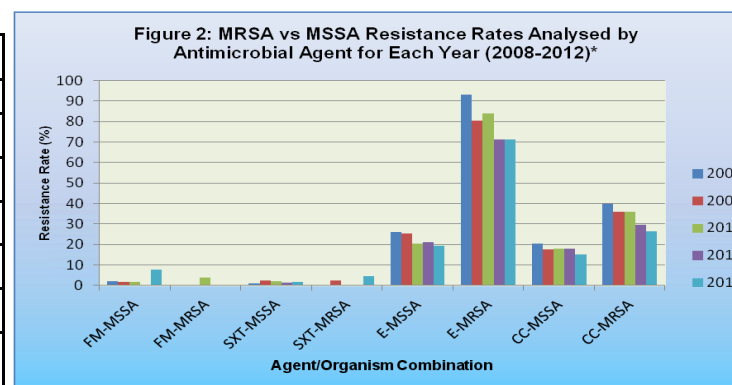


<sup>a</sup>EEN, eye, ear, and nasal specimens; Rsp, respiratory specimens; S, sterile site; SST, skin and soft tissue; U, urine specimens.

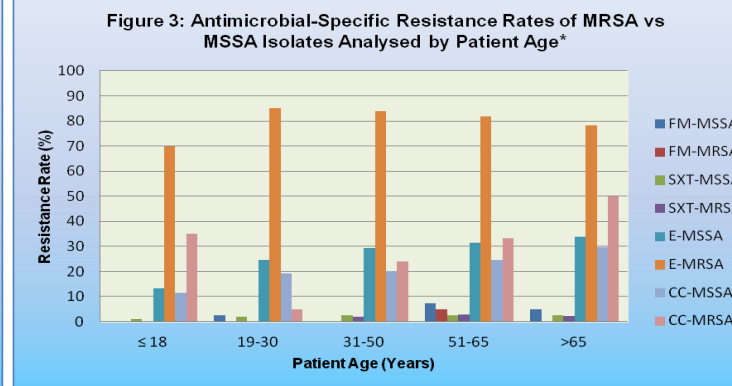
**Antimicrobial Resistance:** MRSA vs MSSA resistance rates for SXT, FM, CC, and E were 1.5 vs 1.7%, 4.5 vs 3.1%, 30.9 vs 17.9% ( $P < 0.001$ ), and 79.4 vs 22.6% ( $P < 0.001$ ), respectively. These results are in agreement with those from other investigators that reported higher rates of resistance of MRSA compared to MSSA against E and CC.<sup>8,10</sup> Table 1 details the numbers and rates of resistant MSSA vs MRSA isolates for each age group.

**Year-to-Year Resistance Rates:** Figure 2 shows the year-to-year resistance rate for each antimicrobial agent tested during each interval. There was a trend for declining *S. aureus* resistance rates over the five years against E. The rates of MRSA and MSSA resistance to E declined from 93.3% in Y1 to 71.1% in Y5 ( $P = 0.02$ ) and from 26.2% in Y1 to 19.3% in Y5 ( $P = 0.05$ ), respectively.

**Effect of Age:** Children had lower rates of MRSA as a proportion of *S. aureus* than did adults (patients older than 18 years of age). Thus, MRSA accounted for 5.4% of all *S. aureus* isolates recovered over the study five years, versus 11.7% of *S. aureus* isolated from adults during the same period, while 12.2% and 13.6% were isolated from patients who were >50 and >65 years of age, respectively (data not shown). In addition, 41% of all MRSA in this study were recovered from patients over 50 years of age (data not shown). Figure 3 compares the resistance rates of MRSA vs MSSA isolates for each antimicrobial agent by patient age group.



<sup>a</sup>CC, clindamycin; E, erythromycin; FM, nitrofurantoin; MRSA, methicillin-resistant *Staphylococcus aureus*; MSSA, methicillin-susceptible *S. aureus*; SXT, trimethoprim-sulfamethoxazole.



<sup>a</sup>CC, clindamycin; E, erythromycin; FM, nitrofurantoin; MRSA, methicillin-resistant *Staphylococcus aureus*; MSSA, methicillin-susceptible *S. aureus*; SXT, trimethoprim-sulfamethoxazole.

## CONCLUSIONS

- Over the past five years, the rate of MRSA isolation from clinical specimens remained relatively stable. The MRSA proportion was highest among skin and soft tissue isolates.
- The likelihood of *S. aureus* being resistant to methicillin increased with age and 41% of MRSA isolates were recovered from patients over 50 years of age.
- MRSA are more likely to be resistant to erythromycin and clindamycin than are MSSA.
- Trimethoprim-sulfamethoxazole continues to have good activity *in vitro* against community isolates of both MSSA and MRSA.

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