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Attributable mortality caused by antimicrobial resistance (AMR) from bloodstream infections (BSIs) in a tertiary hospital in Singapore

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Background

Bloodstream infections (BSIs) caused by methicillin-resistant Staphylococcus aureus (MRSA) and extended-spectrum β-lactamase (ESBL)-producing Escherichia coli have limited therapeutics because of antimicrobial resistance (AMR). This study aimed to quantify attributable in-hospital mortality and hospital length of stay (LOS) associated with AMR BSIs in a tertiary hospital in Singapore.

Methods

We conducted a retrospective cohort study of adult patients admitted between 2018 and 2024 with blood cultures yielding S. aureus or E. coli BSI or negative results. The primary outcome was in-hospital mortality. Secondary outcomes included LOS and intensive care unit (ICU) admission post bacteraemia. Crude mortality differences, logistic regression (in-hospital mortality, ICU admission) and linear regression (LOS) were performed.

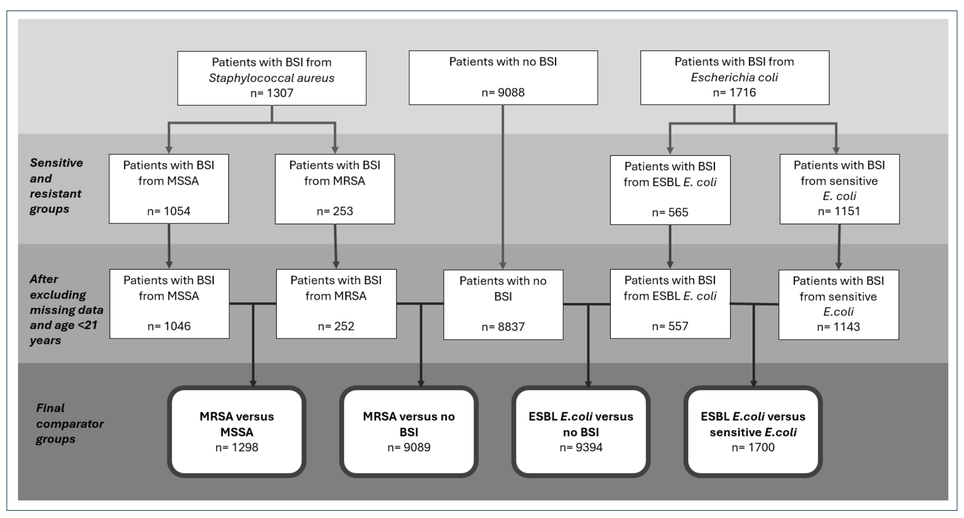

Figure 1: Patient groups within the study

Results

MRSA BSI was associated with higher odds of in-hospital mortality compared to methicillin-sensitive Staphylococcus aureus (MSSA) BSI [adjusted odds ratio (aOR) 1.81, 95% confidence interval (CI) 1.26–2.59, p=0.001] and negative cultures (aOR 5.03, 95% CI 3.57–7.03, p<0.001). ESBL E. coli BSI was not associated with increased in-hospital mortality compared with sensitive E. coli BSI (aOR 0.83, 95% CI 0.62–1.11, p=0.215), but was associated with higher in-hospital mortality compared to negative cultures (aOR 2.06, 95% CI 1.56–2.70, p<0.001).

MRSA BSI was associated with longer LOS, averaging 16.4 days longer than MSSA (95% CI 10.7–22.2, p<0.001) and 30.6 days longer than culture-negative patients (95% CI 28.0–33.3, p<0.001). ESBL E. coli BSI was associated with 5.8 days longer LOS than sensitive E. coli (95% CI 2.2–9.5, p=0.0019) and 16.6 days longer LOS than negative cultures (95% CI 15.0–18.1, p<0.001). There were no associations between AMR BSIs and ICU admission.

Table 1: Demographics, clinical outcomes, and comorbidities of patients stratified by organism group: negative cultures, MSSA, MRSA, sensitive *E. coli*, and ESBL *E. coli*.

Variable	Negative	MSSA	MRSA	*Sensitive E. coli*	ESBL *E. coli*
Demographics					
Number of patients	8,837	1,046	252	1,143	557
Mean age (SD), years	64.3 (16.7)	66.2 (14.3)	67.5 (13.8)	68.7 (14.0)	67.2 (14.3)
Age range, years	21-103	22-98	21-96	21-103	21-101
Male sex	4682 (53.0%)	651 (62.2%)	180 (71.4)	504 (44.1%)	304 (54.6%)
Mean CCI (SD)	5.3 (4.3)	7.0 (3.9)	7.7 (3.6)	7.1 (4.1)	7.7 (4.1)
Clinical outcomes					
Mean LOS (SD), days	11.5 (16.9)	27.5 (26.1)	46.8 (66.9)	25.5 (36.5)	31.5 (40.3)
Median LOS (IQR), days	6 (3-13)	20 (14-32)	28 (17-54)	15 (7-30)	19 (11-36)
LOS range, days	0-320	0-302	0-863	0-594	0-438
In-hospital mortality	495 (5.6%)	197 (18.8%)	73 (29.0%)	194 (17.0%)	88 (15.8%)
ICU admission during hospitalisation	535 (6.1%)	140 (13.4%)	53 (21.0%)	139 (12.2%)	76 (13.6%)
Co-morbidities					
Malignancy	1,660 (18.8%)	176 (16.8%)	49 (19.4%)	359 (31.4%)	204 (36.6%)
Diabetes mellitus	1,937 (21.9%)	277 (26.5%)	63 (25.0%)	306 (26.8%)	123 (22.1%)
Heart disease	1,582 (17.9%)	307 (29.3%)	102 (40.5%)	237 (20.7%)	125 (22.4%)
Peripheral vascular disease	558 (6.3%)	165 (15.8%)	50 (19.8%)	85 (7.4%)	57 (10.2%)
Renal disease	936 (10.6%)	191 (18.3%)	44 (17.5%)	164 (14.3%)	86 (15.4%)
Liver disease	204 (2.3%)	44 (4.2%)	19 (7.5%)	39 (3.4%)	26 (4.7%)
Peptic ulcer disease	186 (2.1%)	45 (4.3%)	13 (5.2%)	39 (3.4%)	27 (4.8%)
Dementia	510 (5.8%)	56 (5.4%)	17 (6.7%)	83 (7.3%)	43 (7.7%)
Cerebrovascular disease	1,547 (15.3%)	219 (20.9%)	66 (26.2%)	192 (16.8%)	95 (17.1%)
Chronic pulmonary disease	835 (9.4%)	102 (9.8%)	27 (10.7%)	66 (5.8%)	42 (7.5%)
Rheumatologic disease	118 (1.3%)	22 (2.1%)	4 (1.6%)	22 (1.9%)	5 (0.9%)
HIV/AIDS	19 (0.2%)	2 (0.2%)	0 (0.0%)	2 (0.2%)	2 (0.4%)

Abbreviations: ESBL, extended-spectrum β-lactamase; ICU, intensive care unit; IQR, interquartile range; LOS, length of stay; MRSA, methicillin-resistant *Staphylococcus aureus*; MSSA, methicillin-susceptible Staphylococcus aureus; SD, standard deviation.

Conclusions

AMR BSIs were associated with longer LOS compared with susceptible strains and negative cultures, and higher in-hospital mortality compared to negative cultures. MRSA BSIs, but not ESBL E. coli BSIs, were associated with higher in-hospital mortality compared to susceptible strains.