An Evaluation of Quality Indicators for the Management of *Staphylococcus aureus* Bacteremia for 30-Day Mortality Outcome: A Nested Case-Control Study

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Background

- *Staphylococcus aureus* bacteremia (SAB) is a serious and often fatal infection and a leading cause of community-acquired (CA) bacteremia. A set of 25 quality indicators in five domains (blood cultures, echocardiography, non-antibiotic interventions, antibiotic treatment, and other management aspects) for the management of SAB was recently created through expert consensus methods by ten Oever and colleagues, but its relevance to the outcome has not been evaluated. We aimed to assess the association between proposed quality indicators and all-cause 30-day mortality for the patients with CA SAB.

Methods

- We conducted a retrospective nested case-control study within a previously identified cohort of SAB patients at Veterans Health Administration (VHA). Patient selection criteria are defined as follows:
  - *Inclusion criteria:*
    - Admitted to acute care VHA hospitals between January 2012 and December 2014
    - Presence of CA SAB defined as onset of bacteremia 96 hours prior to or up to 48 hours following admission
    - Survived for at least 96 hours after the onset of SAB
  - *Exclusion criteria:*
    - Veterans suffering from active metastatic cancer
    - Patient or decision maker opted for hospice care within 30 days of onset of SAB

- Then, we identified paired cases (died within 30 days) and controls (survived for at least 30 days), 1:1 matched for age (+/- 5 years), gender, admission year and month, and methicillin susceptibility of isolates. Patient-level demographic information and comorbidities were also extracted from electronic medical records. Information for quality indicators was abstracted by chart review. The association between quality indicators and mortality was analyzed by a logistic regression model.

Results

	No Death within 30 Days (N=82)	Death within 30 Days (N=82)	p-value		No Death within 30 Days (N=82)	Death within 30 Days (N=82)	p-value
AGE (median [IQR])	68 [62-80]	69.5 [62-80]	0.85	Elixhauser Comorbidities (cont.)			
Male Gender (%)	82 (100.0)	82 (100.0)	1.0	Coagulopathy (%)	16 (19.5)	23 (28.0)	0.27
MRSA (%)	37 (45.1)	37 (45.1)	1	COPD (%)	48 (58.5)	45 (54.9)	0.75
Body Mass Index			0.41	Deficiency Anemia (%)	17 (20.7)	15 (18.3)	0.84
Normal (%)	23 (28.0)	33 (40.2)		Depression (%)	47 (57.3)	43 (52.4)	0.64
Obese (%)	31 (37.8)	24 (29.3)		Drug Abuse (%)	22 (26.8)	22 (26.8)	1.0
Overweight (%)	23 (28.0)	21 (25.6)		Fluid/Electrolytes Dis. (%)	45 (54.9)	51 (62.2)	0.43
Underweight (%)	5 (6.1)	4 (4.9)		Hypothyroidism (%)	15 (18.3)	11 (13.4)	0.52
Elixhauser Cormorbidities				Liver Diseases (%)	21 (25.6)	26 (31.7)	0.49
Diabetes (%)	45 (54.9)	41 (50.0)	0.64	Lymphoma (%)	0 (0.0)	3 (3.7)	0.25
Hypertension (%)	72 (87.8)	68 (82.9)	0.51	Metastatic Malignancy (%)	7 (8.5)	3 (3.7)	0.33
Peptic Ulcer Disease (%)	13 (15.9)	9 (11.0)	0.49	Neurologic Disorders (%)	19 (23.2)	19 (23.2)	1.0
HIV/AIDS (%)	82 (100.0)	82 (100.0)	1.0	Malignancy w/o Metastasis (%)	23 (28.0)	22 (26.8)	1.0
Alcoholism (%)	20 (24.4)	25 (30.5)	0.48	Obesity (%)	32 (39.0)	28 (34.1)	0.63
Arrhythmia (%)	32 (39.0)	47 (57.3)	0.03	Paralysis (%)	9 (11.0)	6 (7.3)	0.59
Rheumatoid Arthritis (%)	11 (13.4)	9 (11.0)	0.81	Psychosis (%)	20 (24.4)	18 (22.0)	0.85
Blood Loss Anemia (%)	4 (4.9)	7 (8.5)	0.53	Pulm. Circulation Dis. (%)	9 (11.0)	12 (14.6)	0.64
Congestive Heart Failure (%)	27 (32.9)	29 (35.4)	0.87	Peripheral Vascular Dis. (%)	32 (39.0)	28 (34.1)	0.63

Table 1. Demographics and Characteristics of Included Patients
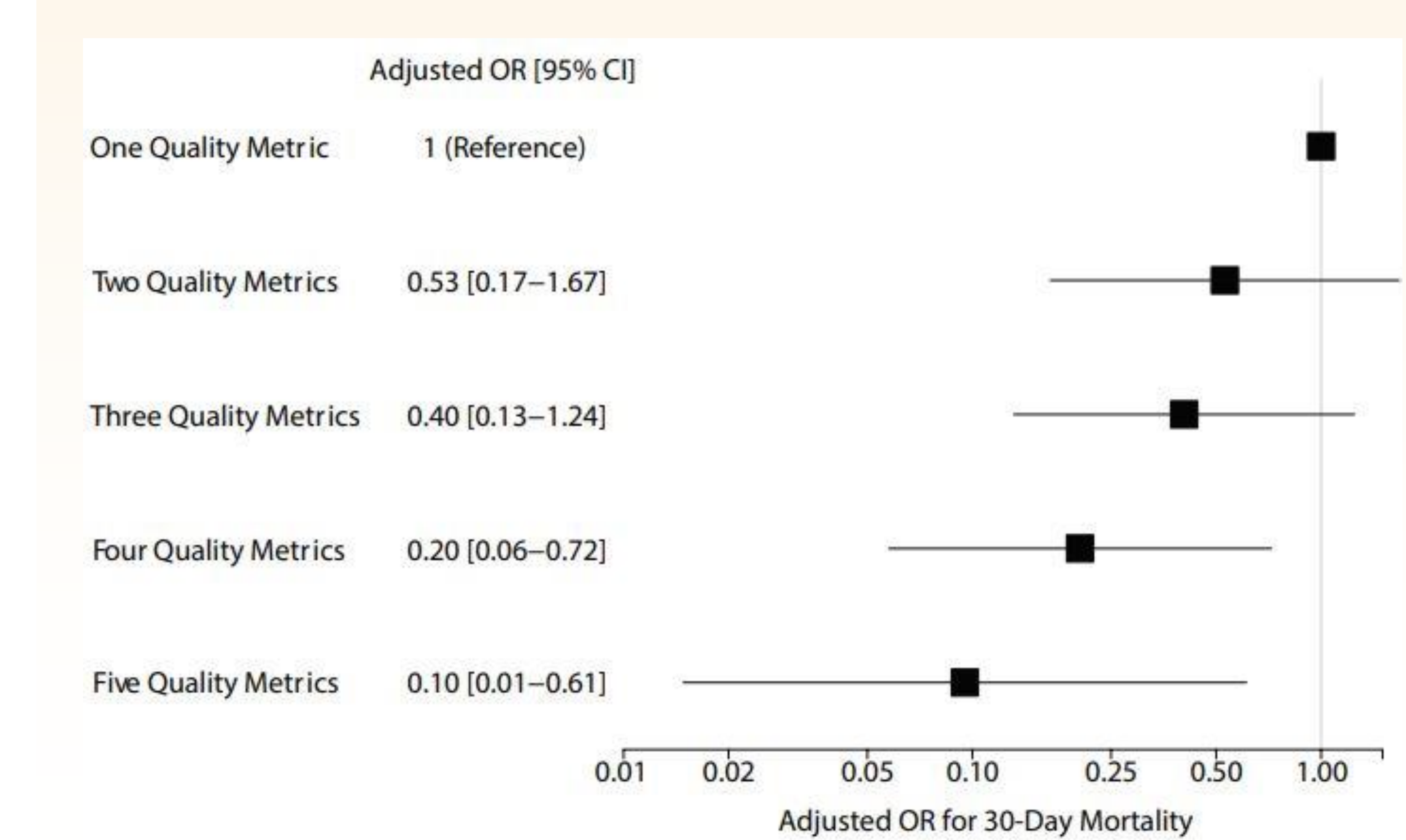

Figure 1: Forest plot demonstrating dose-outcome relationship between satisfied quality metrics and adjusted OR for 30 day mortality. Statistical significance is achieved with satisfaction of 4 or more quality metrics over the course of clinical care of CA SAB.

Results (continued)

- 164 patients (82 each for case and control) were included in the analysis. The median age was 68.5 (IQR: 62-80), and 74 patients (45.1%) had methicillin-resistant isolates. All patients had received at least one domain of quality indicators (median: 3 [IQR: 2-4]). When analyzed individually, only two domains (blood culture: OR 0.27 [95% CI: 0.11-0.68]; source control: OR: 0.13 [0.05-0.31]) had significant associations with 30-day mortality. However, the number of satisfied domains had a dose-outcome relationship (Figure 1).

Discussion

- SAB remains significant cause of morbidity and mortality in all populations, with 30-day mortality rates of over 20%[1]. Despite improvement in supportive care, this number has minimally improved over the last two decades [2]. Results of this study suggest that this substantial morbidity and mortality can be significantly reduced by meeting specific quality metrics throughout the course of clinical care for CA SAB as defined by ten Oever et al [3]. Furthermore, this effect is synergistic as demonstrated in the results section and further solidifies these interventions as evidence based practice rather than merely expert opinion in the clinical management of CA SAB.

Conclusions

- In this nested case-control study for CA SAB, the number of satisfied quality indicator domains had a significant association with all-cause 30-day mortality with a clear dose-outcome relationship. This finding supports the relevance of proposed quality indicators for SAB management.

References

1. Bassetti, M. (2017). Characteristics of Staphylococcus aureus Bacteraemia and Predictors of Early and Late Mortality. https://pubmed.ncbi.nlm.nih.gov/28152067/
2. Wiggli, B.J. (2017). Survival from methicillin-sensitive Staphylococcus aureus bloodstream infections over 20 years: a cohort of 1328 patients. https://pubmed.ncbi.nlm.nih.gov/28975960/
3. Ten Oever, J. (2019). Development of quality indicators for the management of Staphylococcus aureus bacteraemia. Journal of Antimicrobial Chemotherapy, 74(11), 3344–3351.