

Evaluating the Unnecessary Use of Intravenous Broad-Spectrum Antibiotics in Patients Based on Systemic Inflammatory Response Syndrome Criteria in the Emergency Department

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BACKGROUND

Evidence suggests many patients who present to the emergency departments (ED) with suspected sepsis with elevated systemic inflammatory response syndrome (SIRS) criteria may be prematurely diagnosed with sepsis. This leads to the unnecessary administration of intravenous (IV) antibiotics in patients who do not have objective evidence of bacterial disease (e.g., microbiologic, radiographic, or laboratory data).^{1,2} Unnecessary antibiotic use leads to the development of drug resistance, adverse drug events (ADE) such as acute kidney injury (AKI) and *Clostridioides difficile* infections (CDI).^{3,4}

OBJECTIVES

- Evaluate the necessity of IV broad-spectrum antibiotic use for suspected sepsis in the ED by quantifying the number of confirmed bacterial infections in patients who were treated with broad-spectrum antibiotics for suspected sepsis
- Characterize antibiotic-related ADEs in patients who had received IV broad-spectrum antibiotics in the ED for suspected sepsis

METHODS

- Single-center, retrospective review of electronic medical records (EMR) from 01/01/18 to 06/30/18
- Inclusion criteria: Adults (≥ 18 y) admitted to the ED who met ≥ 2 SIRS criteria and received ≥ 1 dose of IV broad-spectrum antibiotic in the ED
- Broad-spectrum antibiotics: aztreonam, cefepime, ceftriaxone, ciprofloxacin, levofloxacin, meropenem, piperacillin/tazobactam, vancomycin
- Exclusion Criteria: 1) Receipt of non-prophylactic, broad-spectrum antibiotics via any systemic route of administration within 72 hours prior to the ED admission; 2) duplicate ED visits during study period; 3) transfers from outside facilities
- Primary outcome: Percentage of confirmed and suspected bacterial infection
- Secondary outcomes: Percentages of antibiotic-related ADE, including in-hospital acute kidney injury (AKI) and CDI; infection with drug-resistant organisms (DRO); 30-day all-cause mortality
- Confirmed infection was defined as: a positive blood culture in concordance with clinical findings or a positive, clinically relevant culture collected during hospitalization in concordance with clinical findings
- Suspected infection was defined as: clinical findings strongly suggestive of a bacterial infection but with negative cultures as documented in EMR by treating physician. Criteria were based on the Centers for Disease Control and Prevention (CDC)/National Healthcare Safety Network (NHSN) Surveillance Definitions⁵
- Absence of infection was neither confirmed nor suspected infection

RESULTS

Figure 1. Presence of Bacterial Disease

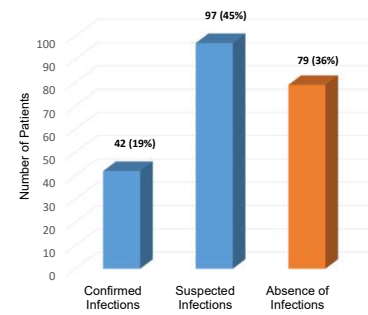


Figure 2. IV Antibiotics Administered in the ED

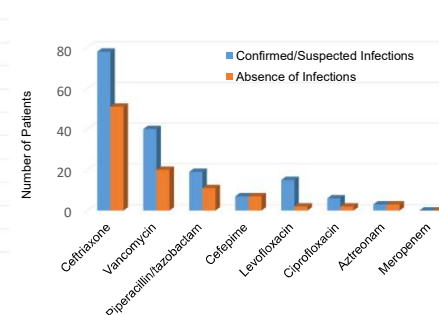


Table 1. Baseline Demographics, SIRS, qSOFA, Discharge Types, Length of Antibiotic Therapies, and Source of Infection of ED Patients with Suspected Sepsis

	Confirmed and Suspected Infections (n = 139)	Absence of Infections (n = 79)	P Value
Age (y), median (range)	50 (19 – 97)	54 (18 – 93)	0.087
Male, No. (%)	56 (40.3)	19 (24.1)	0.015
White race, No. (%)	62 (44.6)	40 (50.6)	0.39
Charlson Comorbidity Index, median (range)	3 (1 – 11)	3 (1 – 12)	0.52
SIRS, No. (%)			
2	87 (62.6)	55 (69.9)	0.30
3	40 (28.8)	22 (27.8)	0.88
4	12 (8.6)	2 (2.5)	0.08
Quick SOFA, No. (%)			
2	5 (3.6)	6 (7.6)	0.19
3	0	0	
Serum lactic acid (mmol/L), median (range)	1.6 (0.7 – 3.2)	1.8 (0.6 – 3.7)	0.61
Serum lactic acid ≥ 2 mmol/L, No. (%)	6 (4.3)	2 (2.5)	0.50
Fluid resuscitation or vasopressor use, No. (%)	17 (12.2)	7 (8.9)	0.44
Discharged from ED, No. (%)	115 (82.7)	64 (81.0)	0.75
Outpatient antibiotic prescribed, No. (%)	104 (74.8)	35 (44.3)	<0.001
Admitted to general wards, No. (%)	20 (14.4)	15 (19.0)	0.37
Admitted to intensive care units, No. (%)	4 (2.9)	0	
Length of therapy during ED and/or hospital admission (d), median (range)			
Broad-spectrum antibiotics	1.0 (0.5 – 10.5)	1.0 (0.5 – 7)	0.17
Length of therapy during ED, hospital admission, and post-discharge (d), median (range)			
Broad-spectrum antibiotics	1.0 (0.5 – 16)	1.0 (0.5 – 14.5)	<0.001
Total antibiotics	8.0 (0.5 – 65)	1.0 (0.5 – 14.5)	<0.001

Table 1 Continued.

Source of infection, No. (%)			
Urinary	63 (45.3)	25 (31.6)	0.048
Respiratory	32 (23.0)	18 (22.8)	0.97
Skin	17 (12.2)	1 (1.3)	0.0047
Abdominal	12 (8.6)	9 (11.4)	0.51
Other	15 (10.8)	26 (32.9)	<0.001
Blood culture obtained, No. (%)	71 (51.1)	38 (48.1)	
Positive result	2 (1.4)	0	
Urine culture obtained, No. (%)	102 (73.4)	62 (78.5)	
Positive result	40 (28.8)	11 (13.9)	

Table 2. AKI, CDI, Drug-Resistant infections, and All-Cause Mortality

	Confirmed and Suspected Infections (n = 139)	Absence of Infections (n = 79)
AKI, in-hospital, No. (%)	0	0
CDI, 90-d, No. (%)	2 (1.4)	5 (6.3)
Drug-resistant organism infections ^a , 90-d, No. (%)	3 (2.2)	4 (5.1)
All-cause mortality, 30-d, No. (%)	1 (0.7)	0

^aMeropenem-resistant *P. aeruginosa*, oxacillin-resistant *S. epidermidis*, vancomycin-resistant *E. faecium*, methicillin-resistant *S. aureus*, cefepime or piperacillin-tazobactam-resistant *Enterobacteriaceae* complex

CONCLUSION

- More than a third of the patients who presented with suspected sepsis (≥ 2 SIRS, providers' suspicion for infection) and received IV broad-spectrum antibiotic in the ED lacked objective evidence of bacterial infections
- Both SIRS and qSOFA were not specific to the presence of bacterial infections
- Although not statistically significant, elevated serum lactic acid (≥ 2 mmol/L) and fluid resuscitation/vasopressor use were more frequently seen in patients with confirmed/suspected infection
- Approximately 80% of patients were discharged directly from the ED
- Despite no evidence of bacterial infection, about half of the patients were prescribed outpatient oral antibiotics
- Length of antibiotic therapy was significantly longer in patients with confirmed/suspected infections
- No significant differences were noted in AKI, CDI, drug-resistant infections, or all-cause mortality between two groups
- The study supports the crucial need to optimize antibiotic use in the ED
- The use of SIRS and qSOFA in accurately identifying sepsis and infection may be suboptimal and likely contribute to unnecessary antibiotic use in EDs

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