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Emergency Department Crowding Delayed Antibiotics but Did Not Increased Mortality for Sepsis?

To the Editor:

We congratulate Peltan et al[1] on their recent article. Emergency department (ED) crowding is a difficult and persistent problem for many hospitals and for patients; it is also a topic of great interest to emergency physicians. The article explored the difference in the time of antibiotics administration in patients with sepsis and the state of ED crowding during administration, and concluded that patients received antibiotics earlier in uncrowded conditions. The conclusion facilitates improvement of awareness of early detection and diagnosis for patients with sepsis, and of early administration of antibiotics. However, we have several questions about this study.

First, there is no recognized best definition for ED crowding. The most commonly used definitions have been numeric counts of patients and process times associated with patient care.[2] Why did the authors choose the ratio of greater than or equal to 1 for registered ED patients to licensed ED beds? They did not describe the indication for admission to ED beds. Should all sepsis patients be admitted to ED beds before receiving antibiotics?

Second, in the retrospective cohort study, patients were included from July 2013 to September 2015. According to the results of ED admission data, the mean pulse rate was 102 beats/min and the respiratory rate was 20.9 and 21.2 breaths/min, respectively. These results met the criteria of systemic inflammatory response syndrome. If according to previous sepsis guidelines[3] this might be diagnosed as sepsis and antibiotic treatment might be started, as the authors showed in Figure 1, many patients should receive antibiotics after the clinician assessment and before laboratory test results are available; however, the authors did not show this in the results. Was there a difference in the proportion of patients between the 2 groups?

Third, according to quick Sequential [Sepsis-related] Organ Failure Assessment (qSOFA) criteria, the results of ED admission data might not have met at least 2 of the following clinical criteria: respiratory rate of 22 breaths/min or greater, altered mentation, or systolic blood pressure of 100 mm Hg or less.[4] However, the authors did not show data such as PaO_2, FiO_2, platelet level, and bilirubin level that are included in the qSOFA.

Fourth, why was the overall hospital mortality rate of sepsis patients receiving earlier antibiotics administration higher (6.2%) than in the group receiving late antibiotics administration (5.3%)? The authors performed body fluid cultures but did not analyze the relevant results. Moreover, the proportion of patients with nighttime and weekend ED arrival was higher in the group with ED occupancy rate less than 1 than the group with ED occupancy rate greater than or equal to 1 (11.8% to 0.8% and 29.4% to 15.7%, respectively). According to our limited experience, patients who arrive during this time often have a serious condition, especially at night. Was the proportion of patients who arrived at nighttime and weekend with a higher qSOFA score and increased the hospital mortality in this study?

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1. Peltan ID, Bledsoe JR, Oniki TA, et al. Emergency department crowding is associated with delayed antibiotics for sepsis. *Ann Emerg Med*. 2019;73:345-355.
2. Hwang U, McCarthy ML, Aronsky D, et al. Measures of crowding in the emergency department: a systematic review. *Acad Emerg Med*. 2011;18:527-538.
3. Levy MM, Fink MP, Marshall JC, et al. 2001 SCCM/ESICM/ACCP/ATS/SIS International Sepsis Definitions conference. *Intensive Care Med*. 2003;29:530-538.
4. Singer M, Deutschman CS, Seymour CW, et al. The Third International Consensus Definitions for Sepsis and Septic Shock (Sepsis-3). *JAMA*. 2016;315:801-810.

In reply:

We thank Drs. Li and Zhang for their interest in our study. The authors highlight how challenging it can be to choose from the numerous metrics of emergency department (ED) crowding used in previous research. We selected a range of validated measures of ED crowding, covering ED input, throughput, and output workload.[1] The primary exposure of ED occupancy rate and the associated definition of ED crowding (ED occupancy rate $\geq$1) were selected according to past validation, generalizability, simplicity, expert recommendations, and broad use in the ED crowding literature generally and the ED sepsis care literature specifically.[1-5] Although we would expect parallel results with simple patient counts applied to a single ED, this method precludes comparisons between EDs of different sizes, including within our multicenter study. The ED occupancy rate in contrast normalizes the total ED census to an individual ED's capacity.

We used the combination of Third International Consensus Definitions for Sepsis and Septic Shock criteria and a discharge diagnosis code consistent with sepsis to identify eligible patients, but did not require a positive fluid culture result for cohort inclusion and do not currently have available the results of collected fluid cultures. The Table depicts subjects' clinical organ failure data and the derived Sequential [Sepsis-related] Organ Failure Assessment component scores based on ED crowding status. We agree that ED crowding varies with time of day and day of the week. Patients presenting on nights and weekends may also exhibit clinical or demographic differences influencing antibiotic timing. To account for this possible confounding, we prespecified inclusion of indicator variables for nighttime and weekend ED presentation in the multivariable models used to measure the adjusted association between ED crowding and door-to-antibiotic time.

Finally, all patients presenting to study EDs were "admitted" to the ED (ie, assigned to an ED bed) for evaluation and treatment. Drs. Li and Zhang draw attention to some challenges in applying our findings to EDs that use alternative models for patient flow. In fact, because our data suggest that crowding-associated delays occurred during the earliest phases of ED sepsis care, triage-based evaluation and treatment initiation could potentially mitigate the effects of ED crowding on antibiotic timing for sepsis. In general, the effects of different ED care process models on the association between sepsis care and ED crowding require further study.

Table. Sequential [Sepsis-related] Organ Failure Assessment component scores and associated clinical data by ED occupancy rate.

SOFA Score Parameter	ED Occupancy Rate <1 (N=3,075)		ED Occupancy Rate ≥1 (N=497)	
SOFA component scores*				
Respiratory	1.6	(0.9)	1.6	(1.0)
Hepatic	0.4	(0.8)	0.4	(0.8)
Cardiovascular	1.0	(1.0)	1.1	(1.0)
Coagulation	0.5	(0.9)	0.6	(0.9)
Central nervous system	0.5	(1.0)	0.5	(1.0)
Renal	0.9	(1.1)	1.0	(1.2)
ED clinical data determining SOFA score†				
Pao_2/Fio_2 ratio	230	(82)	235	(85)
Mechanical ventilation, No. (%)	123	(4.0)	15	(3.0)
Total bilirubin, mg/dL	1.2	(2.0)	1.3	(2.6)
Lowest ED systolic blood pressure, mm Hg	98	(24)	97	(24)
Vasopressor use in ED, No. (%)	137	(4.5)	22	(4.4)
Platelet count, 1,000/dL	225	(116)	219	(114)
Glasgow Coma Scale score	14.6	(1.8)	14.7	(1.5)
Creatinine, mg/dL	1.72	(1.46)	1.80	(1.60)

SOFA, Sequential [Sepsis-related] Organ Failure Assessment.
Values are reported as mean (SD).
*Patients with missing data for SOFA score component calculation had imputation of a normal value.
†Subjects with no data available: Pao_2/Fio_2 ratio-218, total bilirubin-223, platelets-3, and creatinine level-3.