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The Association Between In-hospital Critical Illness Events and Outcomes in Patients on the Same Ward

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To the Editor

Major critical illness events, such as cardiopulmonary arrests and intensive care unit (ICU) transfers, disrupt workflow in a hospital ward. Neighboring ward patients may receive inadequate attention, especially if their care team is distracted by the emergency. Most studies have concentrated on patient-level variables associated with outcomes^{1–3}. To our knowledge, no study has quantified the risk to ward occupants posed by neighboring patients on the same ward experiencing critical illness.

Methods

This observational cohort study of consecutive adult admissions (2009–2013) at the University of Chicago Medicine, where rapid-response teams were used, included 13 medical-surgical wards, which were geographically distinct areas with 4:1 patient-nurse ratios on average and one charge nurse, with approximately 20 beds. Physician teams consisted of one attending and two to three resident trainees or a hospitalist. The university's institutional review board granted a waiver of informed consent.

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The primary outcome was a composite of cardiac arrest and ICU transfer³. The primary exposure was the number of patients on the same ward experiencing a critical illness event (cardiac arrest, ICU transfer, or death) anytime during the prior six hours⁴. Discrete-time survival analysis modeling (using fixed six-hour blocks of time beginning at ward admission) was used to adjust for severity of illness (electronic Cardiac Arrest Risk Triage score³), time of day (day: 7am–5pm, evening: 5pm–10pm, night 10pm–7am), weekday vs. weekend, total number of ward patients, proportion of occupied ICU beds⁵, and specific ward. Analyses were performed using R, version 3.1 (R Project for Statistical Computing), with a two-sided p-value<0.05 denoting statistical significance.

Results

Of 83,723 admissions, 4,286 experienced the primary outcome (179 cardiac arrests and 4,107 ICU transfers). Compared with patients without an event, those with an event were older (60 years vs. 57 years), less likely female (50% vs. 53%), and had a longer median length of stay (12.8 days vs. 3.0 days) (all $P<0.001$).

The likelihood of cardiac arrest or ICU transfer within the next six hours was greater when one event (7.1 per 1,000 patient six-hour time-blocks, 95% CI, 5.0–10.3) or more than one event (5.0 per 1,000 time-blocks, 95% CI, 4.6–5.6) occurred in prior six hours compared to no event (3.6 per 1,000 time-blocks, 95% CI, 3.5–3.8). In the fully-adjusted model (Table 1), when one or more patients developed critical illness, other ward patients' risks for cardiac arrest or ICU transfer increased over the next six hours [1 event: OR 1.18 (95% CI, 1.07–1.31, adjusted absolute risk increase 0.6 per 1,000 six-hour blocks); >1 event: OR 1.53 (95% CI, 1.03–2.18, adjusted absolute risk increase 1.9 per 1,000 six-hour blocks)]. Results remained statistically significant when changing the time window to three and twelve hours (Table 2). The association was not statistically different during nighttime hours [1 event: OR 1.42 (95% CI, 1.17–1.71), p-value for interaction 0.06; >1 event: OR 2.23 (95% CI, 1.07, 4.08), p-value for interaction 0.2], although this analysis is likely underpowered. Severity scores for ICU transfer patients exposed and not exposed to a critical illness event in the prior six hours were not statistically different (mean 39 vs. 37, mean difference of 2 [95% CI, –11–7]). Mortality was also not significantly different between groups (14% vs. 14%, $p = 0.9$). Critical illness events were also associated with a decrease in other patients being discharged from the hospital in the next six hours [1 event: OR 0.94 (95% CI, 0.92–0.96); >1 event: OR 0.95 (95% CI, 0.87–1.04)].

Discussion

Development of a critical illness event in a patient increased the risk of cardiac arrest or ICU transfer in neighboring patients. Although the absolute increased risk is small, these events were associated with high morbidity and mortality.

The association may be explained by the diversion of resources to critically ill patients, which may result in caregivers being less attentive to other ward patients. Study limitations include the retrospective design, single center, unavailability of patient-specific clinician information or reason for admission, and possible residual confounding.

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Table 1

Association between a patient's risk of a cardiac arrest or Intensive Care Unit (ICU) transfer within the next 6 hours and the occurrence of a critical illness event during the previous 6 hours.

Model	OR (95% CI)	
	One event in prior six hours	More than one event in prior six hours
+ unadjusted	1.37 (1.24, 1.51)	1.91 (1.29, 2.70)
+ eCART score	1.35 (1.22, 1.50)	1.87 (1.26, 2.66)
+ shift	1.35 (1.21, 1.49)	1.84 (1.24, 2.61)
+ number of patients in ward	1.32 (1.19, 1.46)	1.77 (1.19, 2.52)
+ mean eCART of ward	1.27 (1.15, 1.41)	1.67 (1.12, 2.38)
+ ward	1.19 (1.07, 1.31)	1.53 (1.03, 2.18)
+ ICU occupancy	1.18 (1.07, 1.31)	1.53 (1.03, 2.18)

OR = Odds Ratio

CI = Confidence Interval

eCART = electronic cardiac arrest risk triage

Table 2

Association between a patient's risk of a cardiac arrest or Intensive Care Unit (ICU) transfer and critical illness events using different time intervals.

Time window	OR (95% CI)	
	One event	More than one event
3 hours	1.18 (1.02, 1.35)	2.51 (1.36, 4.22)
6 hours *	1.18 (1.07, 1.31)	1.53 (1.03, 2.18)
12 hours	1.09 (1.01, 1.19)	1.46 (1.19, 1.77)

* Main analysis