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Association Between Hospital Rates of Early Do-Not-Resuscitate Orders and Favorable Neurological Survival Among Survivors of In-Hospital Cardiac Arrest

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Abstract

Background—Current resuscitation guidelines recommend deferring accurate prognostication after in-hospital cardiac arrest until after 48–72 hours. Among patients who survive in-hospital cardiac arrest, it is unknown whether hospitals vary in making patients DNR early after a successful resuscitation and whether a hospital's rate of early DNR is associated with its rate of favorable neurological survival.

Methods—Within Get With the Guidelines-Resuscitation, we identified 24,899 patients from 236 hospitals who achieved return of spontaneous circulation (ROSC) after in-hospital cardiac arrest between 2006 and 2012. Hierarchical models were constructed to derive risk-adjusted hospital rates of DNR status adoption 12 hours after ROSC and risk-standardized rates of favorable neurological survival (without severe disability; Cerebral Performance Category 2). The association between a hospital's adjusted rate of early DNR and its rate of favorable neurological survival was evaluated using correlation statistics.

Results—Of 236 hospitals, 61.7% were academic, 74% had ≥200 beds, and 94% were urban. Overall, 5577 (22.4%) patients were made DNR 12 hours after ROSC, and risk-adjusted hospital rates of early DNR varied widely (7.1% to 40.5%, median: 22.7% [IQR: 19.3% to 26.1%]; median OR of 1.48). There was also significant hospital variation in risk-standardized rates for favorable neurological survival (3.5% to 44.8%, median: 25.3% [IQR: 20.2% to 29.4%]; median OR 1.72). Notably, there was an inverse relationship between a hospital's risk-adjusted rate of early DNR and its risk-standardized rate of favorable neurological survival ($r = -0.179$, $p = 0.006$).

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DISCLOSURES

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Conclusions—Despite current guideline recommendations, many patients with in-hospital cardiac arrest are made DNR within 12 hours after ROSC, and hospitals vary widely in rates of early DNR. Higher hospital rates of early DNR were associated with worse survival outcomes.

INTRODUCTION

In-hospital cardiac arrest occurs in about 200,000 patients in the United States annually and is associated with a low survival rate of about 20% or less.¹ Given this poor prognosis, discussions regarding resuscitation preferences are reasonable and appropriate for patients who survive an arrest event.² However, a patient's decision to adopt Do-Not-Resuscitate (DNR) status only reflects the preference to have cardiopulmonary resuscitation withheld in the event of a recurrent cardiopulmonary arrest; it should not affect decisions about other medical treatments. Yet, previous studies have shown that DNR status adoption for other medical conditions is associated with lower rates of guideline-adherent treatment and higher mortality.^{3–5} This suboptimal care may be due to clinicians misinterpreting DNR preferences and thus not providing other appropriate therapeutic interventions (e.g., intensive care unit transfer or blood transfusion)^{6,7} or unwarranted pessimism about prognosis in patients made DNR thus leading to a “self-fulfilling prophecy” of poor outcomes.⁸

For patients with in-hospital cardiac arrest who have successful return of spontaneous circulation (ROSC), decisions about future resuscitative efforts are especially difficult in the early post-arrest period because a patient's prognosis may not become clear and evident for as long as 48 to 72 hours after cardiac arrest.⁹ Yet, it is likely that some hospitals are more aggressive in making patients DNR soon after achieving ROSC. Given wide hospital variation in rates of survival for patients with in-hospital cardiac arrest,¹⁰ it is unknown whether hospitals with higher rates of DNR adoption immediately after achieving ROSC have worse outcomes. If so, this may represent a potentially modifiable process, especially in sites with high rates of early DNR adoption.

Accordingly, we leveraged data from Get With the Guidelines (GWTG)-Resuscitation, a large national registry of in-hospital cardiac arrest, to assess whether high hospital rates of DNR in the early period after successful resuscitation from in-hospital cardiac arrest are associated with lower rates of favorable neurological survival (i.e., without severe cognitive disability). If this inverse association exists across hospitals, it may suggest the need for some hospitals to defer decisions about DNR status for a longer period after achieving ROSC (e.g., 2 to 3 days) and ensure that those made DNR are not routinely deprived of other aspects of appropriate care after being resuscitated.

METHODS

Study Design

Sponsored by the American Heart Association, GWTG-Resuscitation is a large, multi-center, observational registry of in-hospital cardiac arrests among U.S. hospitals that was begun in 2000. Hospital participation in the registry is voluntary, and details of the registry have been previously described in detail.¹¹ In short, trained research personnel at each

participating hospital identify and enroll all patients with in-hospital cardiac arrest (defined as unresponsiveness, apnea, and absence of a palpable central pulse), without prior DNR orders, and who have undergone cardiopulmonary resuscitation (CPR). This is accomplished through multiple sources of case identification, including medical records, centralized cardiac-arrest flow sheets, hospital paging-system logs, code cart checks, pharmacy tracer drug records, and hospital billing charges for use of resuscitation medications.^{11,12} Variables are collected prospectively and divided into 6 major categories: facility data, patient demographic data, pre-event data, event data, outcome data, and quality improvement data.¹¹ Standardized data collection methods, including Utstein consensus definitions for all variables and outcomes, and strict oversight across all participating centers ensure accuracy, uniformity and completeness of the data.^{13–15} Outcome, A Quintiles Company, is the data collection coordination center for the American Heart Association/American Stroke Association Get With The Guidelines® programs

Study Population

Information on DNR status was introduced into the data collection form of GWTG-Resuscitation in April of 2006. Thus, our original cohort consisted of 72,875 patients who were 18 years or older and had a documented pulseless in-hospital cardiac arrest between April 2006 and September 2012 (Figure 1). For patients with more than one in-hospital cardiac arrest during a hospitalization, we excluded recurrent (n=7,186) in-hospital cardiac arrests. For the purposes of this study, in which we assessed hospital rates of DNR status after successful resuscitation from in-hospital cardiac arrest, we excluded 31,224 patients who died during the acute resuscitation (i.e., did not achieve ROSC). We also excluded 2,179 patients from hospitals that did not routinely collect information on DNR status after a successful resuscitation. To focus on patients who arrested in either general inpatient or intensive care units (a more homogenous group with respect to causes and characteristics of cardiac arrests), we also excluded 7,311 patients who experienced in-hospital cardiac arrest in the emergency department, operating room, procedural and post-procedural areas. Additionally, we excluded patients with missing data on neurological status if alive at discharge (1,863 patients), as this variable comprised one of our study outcomes, and 3,971 patients for whom we could not calculate timing of DNR decisions due to missing or implausible times. There were no significant differences in baseline characteristics between these patients with missing data and the study cohort (Supplemental Table 1). Finally, we excluded 1,428 patients from hospitals with fewer than 20 patients to ensure each site had sufficient sample size for this study. Our final cohort comprised 24,899 patients who were successfully resuscitated after in-hospital cardiac arrest from 236 hospitals.

Independent Variable and Study Outcome

Our study examined the relationship between hospital rates of early DNR status adoption after successful resuscitation from in-hospital cardiac arrest and corresponding hospital rates of favorable neurological survival to discharge. Since many patients who eventually die become DNR closer to the time of death, and as we were interested in examining whether early DNR decisions correlated with worse survival outcomes, we defined DNR status as a patient for whom a DNR order was placed *within 12 hours* after achieving ROSC from an in-hospital cardiac arrest. Successfully resuscitated patients without DNR orders at any time

during their admission or those with a DNR order placed more than 12 hours after successful resuscitation were defined as non-DNR. To further investigate the impact of using a threshold of 12 hours to define DNR status, we conducted a sensitivity analysis in which DNR status was instead defined as any patient for whom a DNR order was placed *within 72 hours* after achieving ROSC from an in-hospital cardiac arrest.

The primary outcome, favorable neurological survival, was defined as survival to hospital discharge without severe neurological disability. Neurological disability in GWTG-Resuscitation is measured by Cerebral Performance Category (CPC) scores, wherein a CPC of 1 is assigned to patients at discharge with little to no neurological disability, 2 with moderate disability, 3 with severe disability, and 4 for those in a persistent coma or vegetative state. Based on prior work, favorable neurological survival was defined as alive at hospital discharge with a CPC score of 1 or 2,¹⁶ referring to patients with no deficits or those who can still perform independent activities of daily living.¹⁷ We also conducted a secondary analysis in which the outcome was survival to hospital discharge, regardless of neurological status at discharge.

Statistical Analysis

Hospital Rate of Early DNR—We used summary statistics to describe the baseline characteristics of hospitals included in our analysis and simple proportions to calculate each hospital's rate of early DNR among survivors of in-hospital cardiac arrest. Since hospitals may vary in patient case-mix, we constructed a hierarchical, multivariable logistic regression model, with site as a random effect, to compute risk-adjusted rates of early DNR status adoption among hospitals. This model adjusted for patients' age, sex, race, pre-arrest comorbidities (history of myocardial infarction, congestive heart failure, stroke, diabetes, pneumonia, respiratory insufficiency, hepatic insufficiency, renal insufficiency, malignancy, and atrial arrhythmia, as well as myocardial infarction, heart failure, hypotension, trauma, and septicemia during the index hospitalization), and arrest characteristics, including presenting rhythm, event location, duration of acute resuscitation, various pre-arrest interventions in place, and time and day of arrest.

To characterize patients across sites, we then divided hospitals into tertiles by their adjusted rate of early DNR and compared hospital rates of patient characteristics across tertiles using Kruskal-Wallis tests for continuous variables and Mantel-Haenszel trend tests for categorical variables. To quantify hospital variation in rates of early DNR after in-hospital cardiac arrest, we calculated median odds ratios (OR), which assess the likelihood that patients with identical patient-level covariates would be made DNR early after ROSC at one randomly chosen hospital compared with another. The median OR is derived from our aforementioned hierarchical model with only patient-level factors included. A median OR of 1 suggests no variation across hospitals, whereas a median OR of 1.50 suggests a patient has a 50% difference in odds of being made DNR between two randomly selected hospitals.^{18–20}

Association Between Hospital DNR rates and Outcomes—We first calculated risk-standardized survival outcomes for each hospital. Using the validated Cardiac Arrest Survival Post-Resuscitation In-hospital (CASPRI) model, which has been shown to strongly

predict one's likelihood of favorable neurological survival (c-statistic of 0.802) and have excellent calibration,¹⁶ we calculated risk-standardized rates of favorable neurological survival for each hospital. We then evaluated the association between a hospital's risk-adjusted rate of early DNR and its risk-standardized rate of favorable neurological survival using scatter plots and by computing a Pearson's correlation coefficient between these 2 risk-adjusted rates.

The Institutional Review Board (IRB) of the Mid-America Heart Institute approved this study and waived the requirement for informed consent. For all analyses, the null hypothesis was evaluated at a two-side significance level of 0.05 with 95% confidence intervals (CIs). All analyses were conducted with SAS 9.1 (SAS Institute, Cary, NC) and R version 2.6.2.²¹

RESULTS

Of 236 hospitals in the cohort, 61.7% were academic hospitals, 83.0% had 200 beds, and 94% were urban centers (Table 1). There were a total of 24,899 patients with in hospital cardiac arrest in these hospitals. The mean age was 65.0 ± 15.7 years, 43.5% were female and 69.3% were white (Supplemental Table 2). After achieving ROSC, 5577 (22.4%) patients were made DNR within the first 12 hours, and a total of 6039 (24.3%) patients survived to discharge with a favorable neurological outcome.

Variation in Hospital Rates of Early DNR Status Adoption

Unadjusted rates of early DNR status adoption varied across hospitals, with a range of 0% to 58.3% and a median rate of 23.2% (inter-quartile range: 17.3% to 28.6%; Figure 2). After adjustment for demographics, comorbidities, and event characteristics, the range of early DNR status adoption was 7.1% to 40.5%, and the median rate remained similar at 22.7% (inter-quartile range: 19.3% to 26.1%). The adjusted median OR for early DNR adoption was 1.48, suggesting a 48% increased odds of being made DNR early after ROSC at one random hospital compared with another in a patient with similar baseline and cardiac arrest characteristics.

Hospitals in the lowest tertile of early DNR rates made 7.2% to 20.4% of their in-hospital cardiac arrest survivors DNR within the first 12 hours, whereas hospitals in the highest tertile had early DNR rates of 24.9% to 40.5% (Table 2). In general, hospitals in each tertile had similar rates of comorbid conditions, and there were no differences in cardiac arrest rhythm, location of cardiac arrest (e.g., ICU, unmonitored floor), and whether arrests occurred during daytime vs. nighttime by hospital rates of early DNR. Hospitals in the tertile with the highest rate of early DNR did have patients who were older and had higher rates of hypotension or coexisting pneumonia at the time of cardiac arrest. In contrast, hospitals in the lowest tertile had a higher proportion of patients on intravenous vasopressors at the time of cardiac arrest and their patients required longer resuscitations prior to achieving ROSC.

Association of Early DNR Status Adoption with Favorable Neurological Survival

Risk-standardized hospital rates of favorable neurological survival varied across hospitals, with a range of 3.5% to 44.8% and a median rate of 25.3% (inter-quartile range of 20.2% to 29.4%). The adjusted median OR for favorable neurological survival was 1.72, suggesting

substantial variation in survival outcomes across sites. Notably, hospital rates of early DNR for in-hospital cardiac arrest were strongly and inversely correlated with risk-standardized rates of favorable neurological survival (r of -0.179 , $p=0.006$; Figure 3), which suggests that hospitals which were most aggressive at making patients DNR early after ROSC had the lowest risk-standardized rate of favorable neurological outcome, and vice versa. Similar inverse correlations were found in sensitivity analyses defining early DNR as within 72 hours of ROSC (r of -0.114 , $p=0.079$) and defining survival as any survival to discharge (r of -0.137 , $p=0.031$).

DISCUSSION

In this large, national registry, we found that there was wide variation in hospital rates of early DNR status adoption among patients who survived an in-hospital cardiac arrest event, even as most patient and cardiac arrest characteristics were similar across hospitals. Indeed, the median OR for early DNR adoption by successfully resuscitated patients was 1.48 across sites, implying an almost 50% variability in the odds of being made DNR between two hospitals despite similar patient characteristics. Hospitals which made a greater proportion of their successfully resuscitated patients DNR within the first 12 hours after ROSC had lower rates of favorable neurological survival, even after adjusting for patient characteristics, comorbid diseases, severity of illness, and cardiac arrest details (including code duration). Collectively, these results suggest that decisions for making patients DNR immediately after ROSC are not consistent across hospitals and this variability may also be linked to some of the observed hospital variation in survival outcomes after in-hospital cardiac arrest.

For other clinical conditions, point estimates of DNR adoption rates have been reported to vary widely, from 9% to 35%^{3,22–26}. In such studies, patient-level DNR status was associated with higher mortality.^{5,26–28} Moreover, patients made DNR were less likely to receive appropriate medical care unrelated to emergent resuscitation, such as intensive care unit transfer, intravenous antihypertensive therapy, and deep venous thrombosis prophylaxis for intracranial hemorrhage,³ cardiac catheterization and internal cardiac defibrillator placement for out-of-hospital cardiac arrest,²⁵ and left ventricular function assessment, renin-angiotensin system blockade, and diet/lifestyle counseling for heart failure.⁴ Finally, four studies have previously addressed variation across hospitals in regard to early DNR status adoption and associated survival outcomes, albeit in different cohorts of patients with intracranial hemorrhage,²² ischemic stroke,²⁴ traumatic brain injury,²⁹ or out-of-hospital cardiac arrest²⁵ (a very different population than that of patients with in-hospital arrest events^{30,31}). As with our study results, all four prior studies also reported wide variation in hospital rates of DNR status adoption, from 0 to 80%, and worse survival associated with higher hospital rates of DNR.

We extended the findings of prior investigations by examining hospital variation in DNR rates for in-hospital cardiac arrest and its association with favorable neurological survival, a more meaningful outcome for patients than any survival, regardless of quality. In-hospital cardiac arrest is an ideal condition for examining this relationship as it is associated with a low survival rate and the timing of decisions for DNR status is easy to quantify. Although there may be compelling reasons to make a patient DNR, such as severity of illness, overall

prognosis, and patient or family preferences, we found that sites varied widely in how aggressively they established DNR status within 12 hours of the acute resuscitation despite treating very similar patients with in-hospital cardiac arrest. In turn, sites that were less aggressive in making patients DNR altogether or that waited longer to establish DNR in patients were associated with higher overall rates of favorable neurological outcome.

Current resuscitation guidelines recommend waiting 48–72 hours after successful resuscitation from in-hospital cardiac arrest to better assess a patient's prognostic trajectory to allow for more accurate neurological prognosis, as this may not become evident in the immediate aftermath of resuscitation from cardiac arrest.⁹ While prior studies have used a definition of early DNR that includes the first 24 hours after admission, we defined early DNR as within 12 hours of a discrete in-hospital event to which the decision might be more reliably related, in order to highlight that these earlier decisions for resuscitation code status are being made before the time frame recommended for prognostication. Although most patient and cardiac arrest characteristics were similar across hospitals, we did find that two of the strongest prognostic factors for favorable neurological survival—resuscitation time and requirement for continuous intravenous vasopressors at the time of cardiac arrest—were more prevalent in the hospital tertile with the *lowest* early DNR rate, suggesting that unmeasured patient severity of illness is unlikely to fully account for the inverse association between a hospital's early DNR rate and its rate of favorable neurological outcome. In fact, it is quite possible that hospitals with higher rates of early DNR are also less aggressive in other aspects of intensive medical care for its acute survivors of in-hospital cardiac arrest, which may explain their worse survival outcomes. This deserves further study, as a hospital's early DNR rate and its treatment of patients once made DNR—both modifiable processes—may represent potential opportunities to improve survival outcomes for in-hospital cardiac arrest, given wide variation in survival outcomes across hospitals. Such efforts would also be patient-centered, as they would ensure that successfully resuscitated patients are given adequate time for accurate neurological prognostication and remain aggressively treated (outside of a recurrent cardiopulmonary arrest) to optimize outcomes.

Our results should be taken in the context of a number of limitations. Despite our finding of an association between a hospital's rate of early DNR status adoption and worse survival outcome, it remains unknown whether early DNR is a marker or mediator of survival. We did not have information from GWTG-R to determine what prognostic criteria clinicians used to discuss resuscitation code status with patients. Moreover, there may be unmeasured confounders that would account for differences in hospital DNR rates and survival outcomes (e.g., frailty). Nonetheless, it is reassuring that some of the strongest predictors of a non-favorable neurological outcome (resuscitation duration and vasopressors) were more prevalent in hospitals with the lowest early DNR rate. Second, we did not have detailed information as to whether other aspects of care differed among DNR and non-DNR patients across sites to inform whether DNR patients received less aggressive post-resuscitation care. Finally, GWTG-R does not collect detailed information on whether discussions regarding DNR status occurred between patients, their families and the health care team, what their contents were, and what preferences patients or their families might espouse (e.g., spiritual or religious beliefs) that could influence their willingness to receive aggressive post-

resuscitation care. Such unmeasured variables could further mediate the association between hospital rates of DNR status adoption and favorable neurological survival.

In conclusion, we found marked variability across U.S. hospitals in making patients DNR within 12 hours after successful resuscitation from an in-hospital cardiac arrest, despite current guidelines that recommend deferring more accurate prognostication until 48 to 72 hours after successful resuscitation. Hospitals that make a higher proportion of their patients DNR within 12 hours after in-hospital cardiac arrest, in turn, are associated with lower rates of favorable neurological survival. These disparities in care may be improved by better adherence to guideline recommendations to avoid assigning prognosis until 2 to 3 days after experiencing cardiac arrest, and by ensuring that patients who choose DNR status do not have aspects of care withheld inappropriately, but instead receive optimal treatment in accordance with their preferences.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Figure 1. Patient Cohort Exclusion Flow Chart

ROSC, return of spontaneous circulation; DNR, do not resuscitate; ED, emergency department; OR, operating room; CPC, Cerebral Performance Category

Figure 2. Distribution of Early DNR Status Adoption Rates, Across Hospitals

Hospital rates for early DNR status adoption, both, (A) unadjusted, and (B) after multivariable adjustment for demographics, comorbidities, and event characteristics. (DNR, do not resuscitate; IQR, interquartile range)

Figure 3. Association of Early DNR Status Adoption with Favorable Neurological Survival, Across Hospitals

Correlation between hospital rates of favorable neurological survival (adjusted for CASPRI score) and hospital rates of early DNR status adoption, both (A) unadjusted, and (B) after multivariable adjustment for demographics, comorbidities, and event characteristics. (DNR, do not resuscitate; CASPRI, Cardiac Arrest Survival Post-Resuscitation In-hospital)

Table 1

Baseline Characteristics of Participating Hospitals

Characteristics	Proportion (%) (n = 236)
Teaching Status	
Academic	61.7
Non-teaching	38.2
Bed Size	
Small (0–199)	17.0
Medium (200–499)	55.4
Large (≥ 500)	27.6
Ownership	
Non-profit	52.5
Church-affiliated	15.7
State/Local Government	14.7
Private/Investors	13.8
VA/Military	3.2
Region	
North Mid-Atlantic	13.8
South Atlantic	27.6
North Central	21.7
South Central	19.4
Mountain/Pacific	17.5
Location	
Rural	6.0
Urban	94.0
Trauma Center Level	
1 (Regional)	38.8
2 (Community)	41.0
3 (Rural)	19.4
4 (State-defined)	0.7
Urgent Care Center	42.9

Table 2

Baseline Characteristics by Hospital Tertile of Early DNR Rate

All values are medians (inter-quartile ranges) of the hospital rates for each variable in each tertile.

	Tertile 1 low DNR rate (n = 78)	Tertile 2 (n = 79)	Tertile 3 high DNR rate (n = 79)	P-value
DEMOGRAPHICS				
Age, years	65.2 (62.2, 67.3)	66.2 (63.3, 69.4)	67.0 (65.2, 69.0)	0.004
Female, %	44.4 (39.8, 49.0)	43.4 (40.4, 50.0)	44.3 (39.5, 49.7)	0.943
White race, %	69.0 (54.1, 81.4)	74.5 (53.1, 87.6)	77.6 (64.8, 89.7)	0.006
PRE-EXISTING CONDITIONS				
Heart failure this admission, %	14.2 (7.7, 23.7)	18.1 (10.3, 25.4)	17.3 (10.2, 25.8)	0.168
Pre-existing heart failure, %	17.5 (11.7, 23.5)	21.0 (15.8, 27.3)	20.7 (14.7, 26.2)	0.056
Myocardial infarction this admission, %	11.2 (6.7, 15.8)	11.9 (6.5, 19.3)	12.4 (7.5, 18.3)	0.430
Prior myocardial infarction, %	10.6 (5.0, 17.1)	11.8 (6.7, 17.3)	11.5 (7.8, 16.7)	0.565
Arrhythmia, %	26.0 (17.4, 37.7)	32.7 (21.1, 47.1)	32.1 (20.8, 42.5)	0.059
Hypotension, %	24.9 (13.8, 32.1)	29.4 (20.4, 37.3)	28.4 (18.4, 37.0)	0.036
Respiratory insufficiency, %	42.3 (29.1, 54.5)	45.3 (32.9, 53.4)	43.5 (32.4, 54.9)	0.435
Renal insufficiency, %	37.0 (28.9, 43.4)	39.5 (32.6, 45.3)	39.0 (29.9, 46.3)	0.404
Hepatic insufficiency, %	7.8 (3.3, 12.4)	8.3 (4.7, 11.6)	7.3 (4.2, 10.3)	0.657
Metabolic abnormality, %	13.4 (6.4, 22.9)	16.1 (8.7, 25.9)	15.4 (7.4, 23.7)	0.316
Diabetes mellitus, %	32.7 (25.4, 40.6)	33.7 (26.8, 40.6)	34.6 (26.8, 41.2)	0.666
Baseline depressed CNS function, %	8.5 (2.1, 16.3)	10.5 (5.4, 21.7)	8.8 (4.3, 14.8)	0.076
Acute stroke, %	3.3 (1.0, 5.6)	3.4 (2.0, 5.3)	3.6 (0.9, 5.8)	0.590
Acute CNS non-stroke event, %	3.7 (1.2, 9.4)	5.7 (2.8, 10.0)	5.1 (2.6, 8.3)	0.179
Pneumonia, %	13.7 (7.9, 18.2)	17.0 (11.1, 23.5)	15.1 (9.8, 20.8)	0.045
Septicemia, %	20.0 (11.2, 25.4)	19.0 (13.2, 24.6)	19.4 (13.2, 23.8)	0.942
Major trauma, %	1.9 (0.0, 5.6)	1.8 (0.0, 6.8)	0.6 (0.0, 2.8)	0.048
Metastatic/hematologic malignancy, %	11.5 (8.2, 17.0)	10.5 (7.5, 13.5)	9.2 (5.6, 13.5)	0.116
Baseline Cerebral Performance Category				
1 (good performance), %	68.0 (57.7, 87.0)	65.2 (46.9, 82.8)	72.7 (62.8, 82.6)	0.141
2 (moderate disability), %	15.8 (5.6, 28.1)	17.4 (10.3, 31.0)	13.7 (8.2, 24.0)	0.537
3 (severe disability), %	6.9 (2.2, 12.9)	9.2 (3.8, 17.1)	5.6 (3.0, 10.3)	0.027

	Tertile 1 low DNR rate (n = 78)	Tertile 2 (n = 79)	Tertile 3 high DNR rate (n = 79)	P-value
4 (coma or vegetative state), %	2.6 (0.0, 7.2)	3.9 (1.6, 8.0)	2.7 (0.0, 7.4)	0.173
5 (brain death), %	0.0	0.0	0.0	0.134
PRE-ARREST INTERVENTIONS				
Mechanical ventilation, %	35.2 (24.4, 43.2)	31.9 (22.7, 38.9)	31.8 (25.0, 40.8)	0.308
Pacemaker, %	3.8 (1.9, 6.7)	4.7 (1.6, 7.9)	5.4 (2.8, 8.4)	0.205
Antiarrhythmics, %	0.0 (0.0, 1.5)	0.0 (0.0, 1.4)	0.9 (0.0, 2.1)	0.061
Vasoactive agents, %	7.1 (2.6, 12.5)	5.3 (2.5, 9.5)	3.9 (1.3, 8.1)	0.029
Dialysis/extracorporeal filtration, %	2.7 (0.0, 5.9)	3.0 (1.0, 5.7)	2.1 (0.0, 4.9)	0.278
Internal cardiac defibrillator, %	0.0 (0.0, 2.1)	0.9 (0.0, 2.3)	0.0 (0.0, 1.9)	0.245
Intra-aortic balloon pump, %	0.9 (0.0, 3.0)	0.5 (0.0, 2.0)	0.0 (0.0, 1.9)	0.233
EVENT CHARACTERISTICS				
Night, %	32.4 (29.0, 35.5)	32.0 (29.4, 36.2)	33.1 (28.9, 37.5)	0.663
Weekend, %	28.2 (25.9, 31.9)	28.3 (24.8, 31.9)	29.2 (26.1, 33.3)	0.285
Location, %				
Intensive care unit	62.0 (56.0, 68.9)	62.3 (52.7, 68.2)	61.1 (54.2, 68.3)	0.719
Monitored unit	24.5 (17.3, 33.3)	24.5 (19.4, 33.2)	26.4 (20.2, 31.8)	0.868
Non-monitored unit	12.2 (7.6, 16.2)	12.0 (1.9, 17.8)	13.4 (8.1, 21.2)	0.432
Initial cardiac arrest rhythm, %				
Asystole	35.7 (27.7, 42.2)	32.6 (26.4, 44.4)	35.4 (30.6, 40.7)	0.601
Pulseless electrical activity	51.9 (43.5, 61.6)	53.1 (42.1, 62.1)	53.7 (44.8, 60.0)	0.940
Ventricular fibrillation	10.9 (7.0, 14.8)	11.5 (7.4, 16.1)	11.9 (7.3, 13.6)	0.669
Ventricular tachycardia	0.0 (0.0, 1.2)	0.0 (0.0, 1.4)	0.0 (0.0, 1.1)	0.762
Time to ROSC, minutes	15.8 (12.7, 17.3)	13.8 (11.7, 15.7)	13.7 (11.9, 16.5)	0.007

DNR, do not resuscitate; CNS, central nervous system; ROSC, return of spontaneous circulation