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Validation of the Pittsburgh Cardiac Arrest Category illness severity score

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Abstract

Background—The purpose of this study was to validate the ability of an early post-cardiac arrest illness severity classification to predict patient outcomes.

Methods—The Pittsburgh Cardiac Arrest Category (PCAC) is a 4-level illness severity score that was found to be strongly predictive of outcomes in the initial derivation study. We assigned PCAC scores to consecutive in and out-of-hospital cardiac arrest subjects treated at two tertiary care centers between January 2011 and September 2013. We made assignments prospectively at Site 1 and retrospectively at Site 2. Our primary outcome was survival to hospital discharge. Inter-rater reliability of retrospective PCAC assessments was assessed. Secondary outcomes were favorable

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We confirm that the manuscript has been read and approved by all named authors and that there are no other persons who satisfied the criteria for authorship but are not listed. We further confirm that the order of authors listed in the manuscript has been approved by all of us.

We confirm that we have given due consideration to the protection of intellectual property associated with this work and that there are no impediments to publication, including the timing of publication, with respect to intellectual property. In so doing we confirm that we have followed the regulations of our institutions concerning intellectual property.

We further confirm that any aspect of the work covered in this manuscript that has involved human patients has been conducted with the ethical approval of all relevant bodies and that such approvals are acknowledged within the manuscript.

We understand that the Corresponding Author, Dr. Cameron DeZfulian, is the sole contact for the Editorial process (including Editorial Manager and direct communications with the office). He is responsible for communicating with the other authors about progress, submissions of revisions and final approval of proofs. We confirm that we have provided a current, correct email address that is accessible by the Corresponding Author.

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discharge disposition (home or acute rehabilitation), Cerebral Performance Category (CPC) and modified Rankin Scale (mRS) at hospital discharge. We tested the association of PCAC with each outcome using unadjusted and multivariable logistic regression.

Results—We included 607 cardiac arrest patients during the study (393 at Site 1 and 214 at Site 2). Site populations differed in age, arrest location, rhythm, use of hypothermia and distribution of PCAC. Inter-rater reliability of retrospective PCAC assignments was excellent ($\kappa=0.81$). PCAC was associated with survival (unadjusted odds ratio (OR) for Site 1: 0.33 (95% confidence interval (CI) 0.27–0.41)) Site 2: 0.32 (95% CI 0.24–0.43)) even after adjustment for other clinical variables (adjusted OR Site 1: 0.32 (95% CI 0.25–0.41)) Site 2: 0.31 (95% CI 0.22–0.44)). PCAC was predictive of secondary outcomes.

Conclusions—Our results confirm that PCAC is strongly predictive of survival and good functional outcome after cardiac arrest.

Keywords

Critical Care Medicine; Epidemiology; Outcome; Resuscitation

Introduction

Over 500,000 Americans suffer a cardiac arrest annually.¹ Among those with return of spontaneous circulation (ROSC) admitted to the hospital, 50–70% die before discharge. Accurate prognostication of survival, good functional outcome and complications after ROSC can inform medical management, surrogate decision-making and resource allocation. Furthermore, a measure that controls for illness severity using early clinical characteristics would allow prospective stratification or retrospective adjustment in research that examines post-resuscitation care in this heterogeneous population. A number of illness severity scores have been developed for use after cardiac arrest, but rely on information that is not readily available to clinicians in the early hours after ROSC.^{2–4} Further, these scores are intended for use in either in-hospital cardiac arrest (IHCA) or out-of-hospital cardiac arrest (OHCA), but not both.^{2–4} We previously derived an illness severity scale, the Pittsburgh Cardiac Arrest Category (PCAC), that was strongly associated with survival to hospital discharge and good functional outcome in both IHCA and OHCA.⁵ This scale was derived for simplicity, focus on objective physical findings, and relevance to post-arrest patients.

The present study was intended to validate the PCAC. We hypothesized that the PCAC would independently predict survival and functional outcome in two populations of patients hospitalized after cardiac arrest even after adjustment for other variables. Since neurological prognostication may lead to a “self-fulfilling prophecy” whereby care is withdrawn based on perceived prognosis,⁶ we assigned the PCAC *prospectively* at the center where it had been derived and *retrospectively* at another center. Thus, our study was intended to prospectively validate the PCAC in a population similar to the derivation cohort while simultaneously providing external validation to avoid the possibility of bias.

Methods

The University of Pittsburgh Institutional Review Board approved this study.

Setting and Study Population

We included survivors of cardiac arrest that presented to UPMC Presbyterian (Site 1) or UPMC Mercy (Site 2) hospitals and were admitted to the intensive care unit (ICU) between January 2011 and September 2013. Site 1 is a 798-bed tertiary care center with 53,000 emergency department visits annually and is a regional referral center for post-arrest care. Subjects in the original PCAC derivation cohort were cared for exclusively at Site 1 from 2005 to 2009⁵ and were not included in this analysis. Site 2 is a 535-bed tertiary care center with 62,000 emergency department visits annually and serves a primarily local, urban population.

At Site 1, a consulting Post-Cardiac Arrest Service (PCAS) physician consulted on most patients included in this analysis and prospectively assigned each patient's PCAC as part of routine clinical practice. Therefore, the clinical team caring for each patient was aware of both the PCAC and anticipated prognosis. By contrast, a separate group of intensivists staffs Site 2's ICUs without PCAS input minimizing cross contamination. PCAC was not routinely used at Site 2 to inform decision-making or family discussions about prognosis.⁵

We defined "cardiac arrest" as a patient receiving chest compressions by a health care provider. We defined ROSC as regaining and maintaining spontaneous circulation for 20 minutes. We excluded patients from our study if they died less than 6 hours after of ROSC, since PCAC is assigned on the basis of the best neurologic exam in the first 6 hours after ROSC. We included IHCA and OHCA defining emergency department arrests as OHCA.

Treatment during the study period

At Site 1, patients received post-arrest care consistent with our standardized practice guidelines as reported.⁷ This included routine use of mild hypothermia with a target temperature of 33°C maintained for 24 hours. All comatose arrest survivors were treated with hypothermia, regardless of initial rhythm, except those with active, non-compressible bleeding, severe bradycardia or refractory hemodynamic instability. In both OHCA and IHCA patients, providers generally induced hypothermia with rapid intravenous infusion of 4°C crystalloid solutions followed by maintenance with endovascular or surface cooling. We used continuous electroencephalography (EEG) to monitor comatose patients and responded to EEG findings with a standardized antiepileptic medication protocol. Additional care protocols included sedation with propofol or benzodiazepines, narcotic use to prevent shivering, and use of bolus paralytics as needed to facilitate hypothermia induction. We generally recommended maintenance of a mean arterial pressure (MAP) goal 80mmHg for cerebral perfusion. In a majority of patients, the PCAS service led care goal discussions.

At Site 2, the intensivist group used an identical induced hypothermia and sedation protocol. Intermittent EEG monitoring was used at the discretion of the treating intensivist. Care protocols recommended fluids and vasoactive medication to maintain MAP 65mmHg and urine output 0.5mL/kg/h.⁸ The treating intensivist led care goal discussions without PCAS input.

Data Collection

We collected patient demographics including age, sex, initial arrest rhythm (ventricular tachycardia or fibrillation (VT/VF), pulseless electrical activity (PEA), asystole, unknown), location of arrest (OHCA or IHCA), and Charlson Comorbidity Index. We assigned PCAC as previously described.⁵ The PCAC is derived from the Full Outline of UnResponsiveness (FOUR)⁹ brainstem and motor sub-scores and the Serial Organ Failure Assessment (SOFA)¹⁰ cardiac and respiratory subscales (Supplemental Table1). The four PCAC levels are:⁵

- i. Awake (FOUR motor + brainstem = 8); 80% survival, 60% good outcome
- ii. Coma (not following commands but intact brainstem responses; FOUR motor + brainstem of 4–7) and mild cardiopulmonary dysfunction (SOFA cardiac + respiratory score <4); 60% survival, 40% good outcome
- iii. Coma (as defined above) with moderate to severe cardiopulmonary dysfunction (SOFA cardiac + respiratory score ≥ 4); 40% survival, 20% good outcome
- iv. Coma with at least one absent brainstem reflex (FOUR motor + brainstem < 4); 10% survival, 5% good outcome

We used the best neurological examination within 6 hours after ROSC to assign FOUR score. Patients were examined free of sedation and neurological blockade before consideration of hypothermia. No exams clouded by drugs were considered. We used the worst SOFA score in the first 6 hours after ROSC to derive PCAC scores. Our methods of assigning PCAC were identical to the derivation study.⁵

At Site 1, the PCAS physician prospectively assigned the PCAC. At Site 2, a single study investigator assigned PCAC based on retrospective medical record review. To assess the inter-rater reliability of retrospective PCAC assignment, three investigators independently assigned PCAC to a random sample of 32% of Site 2 patients.

Outcomes

Our primary outcome was survival to hospital discharge. Secondary outcomes were discharge Cerebral Performance Category (CPC), discharge modified Rankin Scale score (mRS) and discharge disposition, which we operationalized as a three-level categorical variable (home or acute inpatient rehabilitation; nursing facility or hospice; death). At both sites, we assigned neurological outcomes retrospectively based on review of physical medicine and rehabilitation, physical therapy, occupational therapy and nursing documentation.^{11,12} We categorized cause of death as hemodynamic instability, brain death, withdrawal of care for medical reasons (other than neurological prognosis), or withdrawal for anticipated neurological prognosis. At both sites, patients are generally discharged to rehabilitation when their CPC reaches 3, so in our setting discharge CPC does not reflect patients' ultimate recovery. Since 90% of our arrest survivors who go to acute inpatient rehabilitation ultimately are discharged home, "good functional outcome" was operationalized as discharge to home or rehabilitation.

Statistical analysis

We tested the unadjusted association of each candidate predictor with outcomes using logistic regression or chi-square tests and report odds ratios with 95% confidence intervals for logistic regression and P-values for both. We constructed and adjusted models to test the independent association between PCAC and outcomes. To avoid overfitting, we included only predictors with an unadjusted $P < 0.10$. We excluded use of therapeutic hypothermia because of co-linearity with PCAC. We tested the goodness-of-fit of each models using pseudo- R^2 and Hosmer-Lemeshow statistics. We repeated our analyses treating PCAC as a categorical and continuous predictor. We calculated a Kappa statistic for the subset of patients with two PCAC values assigned retrospectively.

Results

A total of 607 subjects with cardiac arrest were admitted during the study period (393 at Site 1 and 214 at Site 2). Subjects at Site 2 tended to be older, with a higher prevalence of PEA, IHCA, and received therapeutic hypothermia less frequently (Table 1). Baseline characteristics were similar across PCAC levels (Table 1). The frequency of IHCA and VF/VT decreased across PCAC levels while use of hypothermia increased. Inter-rater reliability of retrospective PCAC assignment yielded a kappa score of 0.81.

At both sites, outcomes worsened as PCAC increased (Table 2, Figure 1) and the distribution of outcomes didn't differ between the two cohorts (Table 2). After adjustment for PCAC, survival was not significantly different between Site 1 and Site 2 and was similar to the PCAC derivation cohort (Figure 1).⁵ Modeling PCAC as a categorical variable or a continuous did not change the point estimates or goodness of fit (Supplemental Table 2).

In unadjusted analysis, age, initial rhythm of VF/VT, OHCA, PCAC and therapeutic hypothermia were associated with survival (Table 3), neurological outcome and favorable discharge disposition (Table 4). In adjusted analyses, PCAC remained significantly associated with all outcomes (Table 4), with satisfactory goodness of fit (Supplemental Table 3) and correct classification in each model (Supplemental Table 4.) Receiver operator curves testing PCAC were significant for all outcomes (Site 1: Survival AUC 0.82; good functional outcome AUC 0.77; discharge CPC 1–2 AUC 0.79; discharge mRS 0–3 AUC 0.78; Site 2: Survival AUC 0.83; good functional outcome AUC 0.80; discharge CPC 1–2 AUC 0.83; discharge mRS 0–3 AUC 0.80).

Discussion

We demonstrate that PCAC is strongly associated with survival to hospital discharge and good functional outcome. This association is similar regardless of whether PCAC was assigned prospectively or retrospectively. Importantly, we have confirmed reproducibility of this association in two different hospital settings with demographically distinct patient populations and care practices. Finally, we have demonstrated excellent inter-rater reliability when PCAC is retrospectively assigned. Although serial physical examination, neurophysiologic testing, imaging and blood markers can improve prognostic accuracy,

none of these have been reported to have stronger individual associations with outcome than PCAC.¹³

The PCAC has several benefits over other post-arrest illness severity scores.^{14,15} It may be applied to both IHCA and OHCA. PCAC depends only on characteristics that can be assessed clinically early after ROSC-- the neurologic exam and the patient's cardiorespiratory failure. Additional historical elements which may not be delayed or unavailable are not required. As a result, PCAC is rapidly and easily assigned. The PCAC also allows a graded estimate of the probability of good functional outcomes, which is novel. The ability to both rapidly prospectively and retrospectively assign PCAC provides a strong justification for its use in future observational and randomized studies of post-resuscitation care.

PCAC by its design reflects the degree of neurologic (FOUR score) and cardiopulmonary (SOFA score) injury after cardiac arrest with more weight given to neurologic injury. These factors have been independently validated as the most important factors influencing outcomes after cardiac arrest.^{6,16,17} Patients with OHCA tended to have higher PCAC scores, while age and comorbidity index did not vary across PCAC categories. Recent studies^{18,19} have reported better outcomes with IHCA compared to OHCA and improved outcomes after VF/VT are also well established^{19,20,21}. We report consistent associations with arrest characteristics and outcome, noting that PCAC still independently predicted survival and good functional outcome after controlling for such characteristics.

Several other illness severity scores accurately predict outcomes after cardiac arrest. The OHCA score, developed by Adrie and colleagues,² provides a very good prediction of survival to hospital discharge with an area under the receiver operator curve of 0.88. However, this score requires accurate knowledge of low-flow and no-flow times which is challenging in most systems and rarely available early post-arrest,²² as well as calculation of natural logarithms which is more complex. Further, the score is only designed for survivors of OHCA. The Cardiac Arrest Survival Post-Resuscitation In-hospital (CASPRI) score developed by Chan and colleagues³ also had many strengths including derivation and validation in the large Get-With-the-Guidelines (GWTG) IHCA registry, a C-statistic of 0.80, and calculation using readily available information in IHCA cases such as duration of resuscitation, initial rhythm, and subject age. While the CASPRI score accurately predicts survival with good neurological function, it does not take into account the probability of survival with neurological impairment. The factors used in calculating the CASPRI score are specific to IHCA and have not been evaluated in OHCA. Nonetheless, CASPRI performs better than APACHE III which was not designed specifically for post-cardiac arrest patients.²³ Indeed APACHE II has modest predictive ability beyond 24 hours after cardiac arrest but is not accurate at baseline.²⁴ The Good Outcome Following Attempted Resuscitation (GO-FAR) score also derived for IHCA using the GWTG database provides for a graded prognosis similar to PCAC but depends on scoring based on 13 characteristics.⁴ A number of these characteristics are based on the patient's past medical history and may not be available early after ROSC nor accurately reflected in the medical record when retrospectively abstracted for the purposes of injury severity adjustment in post-resuscitation care studies.

Many authors recommend that neurological prognostication be delayed for at least 72 hours after ROSC^{25,26} and recent guidelines advocating for longer delays when induced hypothermia is used.²⁷ Our data *do not* support early termination of aggressive support on the basis of any single test such as the PCAC: even the worst PCAC category may have a 10% probability of survival and a 5% probability of good neurological outcome. Instead, the PCAC provides a baseline prognostic estimate that should be revised to incorporate data from subsequent examinations and testing. In studies of end of life decision making, surrogate decision makers report a desire to receive early communication from their physicians and to be prepared gradually for poor outcomes.²⁸ In this regard, PCAC has utility to provide objective data for prognosis discussions with surrogate decision makers.

A shared criticism of illness severity scores and other prognostic tools used after cardiac arrest and neurological critical care is the concern for self-fulfilling prophecies: a prognostic indicator is viewed to indicate a low likelihood of good outcome and leads to withdrawal of care, thus ensuring that future evaluations of the prognostic indicator confirm that it is strongly associated with mortality.^{29–32} In this study, we have attempted to address this issue by retrospectively assigning PCAC to a population where it was not used in clinical decision-making, and by reporting cause of death for both study sites. The rate of withdrawal of care due to anticipated neurologic prognosis was similar between Site 1 and Site 2 overall, as well as PCAC sub groups including PCAC IV patients that appear neurologically devastated on presentation. This finding suggests that prospective utilization of the PCAC did not lead to a self-fulfilling prophecy. A similar validation has not been performed with other post-arrest illness severity scores.

One goal in developing the PCAC was to have a means to adjust for cardiac arrest injury severity in future studies evaluating the efficacy of post-resuscitation care. Recent reports demonstrate improvements in outcomes from IHCA¹⁸ and OHCA,³³ but these large observational reports also reported increases in the rate of ROSC. It is impossible to determine if post-resuscitation care contributed to these improved outcomes or if more patients arrived to the ICU with lower post-ROSC injury severity due to improved resuscitation. Adjustment for an early illness severity score such as PCAC would permit such a comparison even in the setting of post-resuscitation heterogeneity.

Despite these strengths, we acknowledge several limitations in our study. Arbitrary clinical decisions such as the choice of vasopressors agents can lead to different classification by the SOFA cardiovascular score³⁴ which would change the assignment of some patients in PCAC II and III groups. While both Site 1 and Site 2 saw distinct patient populations during the study period, each hospital is part of the same network in the same region; thus, PCAC has not been tested in other geographical regions. The derivation (prior study) and validation (this study) cohorts for the PCAC amount to approximately 1000 patients which is smaller than other studies using large databases such as GWTG. However, determination of the PCAC score based on the FOUR score components (i.e. neurological exam) requires a granularity frequently unavailable in large administrative datasets. At Site 2, the FOUR score was not assessed or documented routinely by emergency and intensive care physicians requiring data abstracters to calculate this score retrospectively from medical records which was time consuming. The similar performance between PCAC calculated retrospectively by

this method and PCAC assigned prospectively is reassuring that this score can be derived from medical records if needed.

We report CPC, mRS and discharge disposition as each represents unique aspects of patient outcome. Each is associated with long-term function.^{12,35} While imperfect, these are the current standards for outcome reporting after cardiac arrest though development of more patient-centered outcome measures is ongoing. Although we systematically recorded the best SOFA and FOUR scores in the first 6 hours after ROSC to determine PCAC, the precise timing of each subject's best scores varied and multiple exams were often documented. In our experience, the neurological exam is dynamic early after ROSC making it important to reexamine subjects to accurately assign PCAC. Our decision to limit adjudication of PCAC and its components to the first 6 hours after arrest was based on clinical observation and ease of use. There is a distinct subgroup of post-arrest patients who achieve ROSC but remain in severe cardiopulmonary failure. In the absence of ECMO many of these patients cannot be stabilized and die. The anticipated clinical course for this cohort is generally evident to the treating clinician, so estimation of injury severity is not helpful. Conversely, allowing up to 6 hours for examination provides sufficient time for clearance of medications that could cloud the neurologic exam.

Conclusion

PCAC, an illness severity score derived in a previous cohort of IHCA and OHCA patients, predicted survival and functional recovery in two different cohorts. This score can be calculated in all cardiac arrest survivors early after ROSC using information readily available to clinicians. PCAC is a useful method for making early estimates of prognosis and can be used to adjust for injury severity in future studies of post-resuscitation care.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Appendix

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Figure 1.
Distribution of PCAC and survival by hospital site.

Table 1

Demographic characteristics of Site 1 and Site 2.

Characteristic	PCAC I		PCAC II		PCAC III		PCAC IV		Overall	
	Site 1	Site 2	Site 1	Site 2	Site 1	Site 2	Site 1	Site 2	Site 1	Site 2
N	99	61	64	32	47	37	183	84	393	214
	25%	29%	16%	15%	12%	17%	47%	39%		
Age*	63	62	59	61	61	62	57	59	59	62
	(6)	(5)	(16)	(16)	(17)	(17)	(7)	(17)	(17)	(16)
Male	55	42	40	17	34	20	112	46	241	125
	56%	69%	63%	53%	72%	54%	61%	55%	61%	58%
OHCA*	54	24	47	13	28	15	152	55	281	107
	54%	39%	73%	40%	59%	41%	83%	51%	71%	50%
Initial Rhythm*										
VT/VF	50	23	32	8	16	9	33	12	131	52
	51%	37%	51%	25%	34%	24%	18%	14%	33%	24%
PEA	27	25	19	12	15	18	59	36	120	91
	27%	41%	29%	37%	32%	49%	32%	43%	30%	42%
Asystole	12	9	6	5	12	8	60	22	90	44
	12%	15%	9%	15%	25%	21%	33%	26%	23%	20%
Unknown	10	4	7	7	4	2	31	14	52	27
	10%	6%	11%	22%	8%	5%	17%	17%	13%	12%
CCI	1.7	2.2	1.8	2.0	1.9	1.9	1.6	1.6	1.7	1.9
	(2.1)	(1.9)	(2.0)	(1.7)	(1.9)	(1.5)	(1.8)	(1.7)	(1.9)	(1.7)
Hypothermia*	5	16	62	20	42	26	180	69	289	131
	5%	26%	97%	63%	89%	70%	98%	82%	73%	61%

* P<0.01 across categories within a site. Data are presented as mean (standard deviation) or n % with corresponding percent of patient in each category at each study site.

Abbreviations: OHCA – Out of hospital cardiac arrest; VT/VF – Ventricular tachycardia or fibrillation; PEA – Pulseless electrical activity; CCI – Charlson Comorbidity Index; PCAC – Pittsburgh Cardiac Arrest Category

Table 2

Outcome measures of Site 1 and Site 2.

Outcome	PCAC I		PCAC II		PCAC III		PCAC IV		Overall	
	Site 1	Site 2	Site 1	Site 2	Site 1	Site 2	Site 1	Site 2	Site 1	Site 2
Number in group	99	61	64	32	47	37	183	84	393	214
Survival to discharge *	76 77%	45 75%	43 67%	21 59%	21 49%	13 33%	22 12%	7 8%	162 41%	87 41%
Discharge disposition *										
Home or acute rehab	46 47%	33 54%	31 48%	9 28%	9 19%	6 16%	9 5%	3 3%	95 24%	51 24%
Nursing facility, hospice, or morgue	53 53%	28 46%	33 52%	23 72%	38 81%	31 84%	174 95%	81 97%	298 76%	163 76%
Cerebral Performance Category *										
1-2	42 42%	29 47%	21 33%	6 19%	9 19%	5 13%	6 3%	1 1%	78 20%	41 19%
3-5	57 58%	32 53%	43 77%	26 81%	38 81%	32 87%	177 97%	83 99%	315 80%	173 81%
Modified Rankin Scale *										
0-3	41 42%	29 48%	22 34%	7 22%	9 9%	6 16%	5 2%	2 2%	77 20%	44 21%
4-6	58 58%	32 52%	42 66%	25 78%	31 91%	31 84%	178 98%	82 98%	316 80%	170 79%
Cause of death (n - percent of non-survivors) *										
Withdrawal – medical	10 43%	8 53%	2 9%	2 18%	4 16%	7 29%	15 9%	6 8%	31 13%	23 19%
Withdrawal – neurological	3 13%	3 20%	14 67%	7 63%	15 62%	11 46%	93 57%	56 73%	125 54%	77 61%
Brain death	0 0%	0 0%	0 0%	1 9%	1 4%	1 4%	24 14%	10 13%	25 11%	12 9%
Other	10 43%	4 27%	5 24%	1 9%	4 17%	5 21%	31 19%	5 6%	50 22%	15 11%

* P<0.01 across categories. Data are presented as raw number with corresponding percent of patient in each category at each study site, except cause of death which is presented as raw number with the percentage of the site's non-survivors. Other causes of death include re-arrest without successful resuscitation, intractable shock, and hemodynamic instability.

Table 3

Unadjusted logistic regression testing the association between Pittsburgh Cardiac Arrest Category and other demographic variables with patient outcomes.

Model	PCAC	Age	Male	VT/VF	OHCA	Hypothermia	CCI
Survival to hospital discharge							
Site 1	0.33 (0.27–0.41) [†]	0.99 (0.98–1.01)	0.90 (0.60–1.36)	4.22 (2.70–6.58) [†]	0.78 (0.50–1.22)	0.14 (0.82–0.23) [†]	0.92 (0.82–1.02)
Site 2	0.32 (0.24–0.43) [†]	0.99 (0.97–1.01)	2.12 (1.20–3.76) [†]	4.90 (2.49–9.63) [†]	0.51 (0.30–0.90) [†]	0.34 (0.19–0.60) [†]	0.92 (0.78–0.08)
Favorable discharge disposition							
Site 1	0.42 (0.34–0.52) [†]	0.98 (0.96–0.99) [†]	0.93 (0.58–1.49)	5.14 (3.15–8.42) [†]	1.82 (1.04–3.17) [†]	0.27 (0.17–0.45) [†]	0.69 (0.59–0.82) [†]
Site 2	0.35 (0.25–0.49) [†]	0.98 (0.96–1.00) [†]	3.2 (1.54 – 6.71) [†]	9.68 (4.70–19.94) [†]	1.11 (0.59–2.09) [†]	0.49 (0.26–0.93) [†]	0.85 (0.69–1.04) [†]
Discharge CPC of 1–2							
Site 1	0.40 (0.31–0.51) [†]	0.98 (0.97–1.00) [†]	1.16 (0.96–1.94)	3.89 (2.32–6.51) [†]	1.87 (1.01–3.45) [†]	0.21 (0.12–0.36) [†]	0.74 (0.22–0.88) [†]
Site 2	0.29 (0.19–0.44) [†]	0.97 (0.95–0.99) [†]	3.48 (1.52–7.99) [†]	5.87 (2.81–12.26) [†]	1.00 (0.50–1.99)	0.21 (0.12–0.36) [†]	0.79 (0.63–1.00) [†]
Discharge mRS of 0–3							
Site 1	0.39 (0.31–0.50) [†]	0.98 (0.97–1.00) [†]	0.86 (0.52–1.43)	6.24 (3.63–10.72) [†]	2.25 (1.18–4.27) [†]	0.22 (0.13–0.37) [†]	0.64 (0.52–0.78) [†]
Site 2	0.35 (0.25–0.50) [†]	0.97 (0.95–0.99) [†]	4.10 (1.80–9.33) [†]	6.97 (3.38–14.38) [†]	1.12 (0.58–2.18) [†]	0.39 (0.20–0.77) [†]	0.74 (0.58–0.94) [†]

[†] P < 0.05 across categories.

Abbreviations: PCAC – Pittsburgh Cardiac Arrest Category; VT/VF – Ventricular tachycardia or fibrillation; OHCA – Out of hospital cardiac arrest; CCI – Charlson Comorbidity Index; CPC – Cerebral Performance Category; mRS – modified Rankin Scale

Adjusted logistic regression testing the association between Pittsburgh Cardiac Arrest Category and other demographic variables with patient outcomes.

Table 4

	Covariate						
	PCAC	Age	Male	VF/VT	OHCA	CCI	
Survival to discharge							
Site 1	0.32 (0.25–0.41) [†]	0.98 (0.96–1.00) [†]	1.02 (0.60–1.75)	2.63 (1.52–4.54) [†]	1.34 (0.72–2.49) [†]	0.94 (0.81–1.09)	
Site 2	0.31 (0.22–0.44) [†]	1.00 (0.98–1.02)	1.47 (0.68–3.16)	4.66 (1.87–11.64) [†]	0.42 (0.19–0.95)	0.77 (0.65–0.98)	
Favorable discharge disposition							
Site 1	0.35 (0.26–0.46) [†]	0.96 (0.94–0.98) [†]	1.09 (0.59–2.01)	3.59 (1.96–6.56) [†]	2.63 (1.26–5.47) [†]	0.79 (0.65–0.96) [†]	
Site 2	0.32 (0.21–0.48) [†]	0.98 (0.95–1.00)	3.51 (1.30–9.45) [†]	8.12 (3.18–20.76) [†]	1.24 (0.47–3.24)	0.86 (0.66–1.13)	
Discharge CPC of 1–2							
Site 1	0.32 (0.24–0.43) [†]	0.97 (0.95–0.99) [†]	1.65 (0.87–3.14)	2.17 (1.43–6.56) [†]	3.06 (1.43–6.56) [†]	0.86 (0.71–1.04)	
Site 2	0.28 (0.17–0.44) [†]	0.97 (0.94–1.00)	3.75 (1.30–10.78) [†]	4.23 (1.61–11.16) [†]	1.32 (0.48–3.65)	0.78 (0.58–1.04)	
Discharge mRS of 0–3							
Site 1	0.33 (0.24–0.45) [†]	0.97 (0.95–0.99) [†]	0.95 (0.49–1.85)	4.36 (2.25–8.46) [†]	3.52 (1.55–7.99) [†]	0.73 (0.59–0.92) [†]	
Site 2	0.31 (0.20–0.47) [†]	0.97 (0.94–0.99) [†]	4.67 (1.61–13.50) [†]	4.76 (1.85–12.28) [†]	1.37 (0.51–3.72)	0.74 (0.55–0.99) [†]	

[†] P < 0.05 across categories.

Abbreviations: PCAC – Pittsburgh Cardiac Arrest Category; VT/VF – Ventricular tachycardia or fibrillation; OHCA – Out of hospital cardiac arrest; CCI – Charlson Comorbidity Index; CPC – Cerebral Performance Category; mRS – modified Rankin Scale.