Published in final edited form as:

Acad Emerg Med. 2010 April ; 17(4): 391–398. doi:10.1111/j.1553-2712.2010.00707.x.

Out-of-Hospital Cardiac Arrest in Denver, Colorado: Epidemiology and Outcomes

Jason S. Haukoos, MD, MSc^{1,2,3}, Gary Witt, MD¹, Craig Gravitz, EMT-P, RN⁴, Julianne Dean, DO¹, David M. Jackson, MD, MS^{1,3}, Thomas Candlin, EMT-P⁵, Peter Vellman, MD⁵, John Riccio, MD⁶, Kennon Heard, MD^{3,7}, Tom Kazutomi, EMT-P^{8,9}, Dylan Luyten, MD¹⁰, Gilbert Pineda, MD^{11,12}, Jeff Gunter, MD¹³, Jennifer Biltoft, PharmD¹⁴, and Christopher Colwell, MD^{1,9}

¹Department of Emergency Medicine, Denver Health Medical Center, Denver, Colorado

²Department of Epidemiology, Colorado School of Public Health, Aurora, Colorado

³University of Colorado Denver School of Medicine, Aurora, Colorado

⁴Department of Surgery, Denver Health Medical Center, Denver, Colorado

⁵Department of Emergency Medicine, St. Anthony Central Hospital, Denver, Colorado

⁶Department of Emergency Medicine, Porter Adventist Hospital, Denver, Colorado

⁷Department of Emergency Medicine, University of Colorado Hospital, Denver, Colorado

⁸Department of Emergency Medicine, Rose Medical Center, Denver, Colorado

⁹Denver Paramedic Division, Denver Health Medical Center, Denver, Colorado

¹⁰Department of Emergency Medicine, Swedish Medical Center, Englewood, Colorado

¹¹Department of Emergency Medicine, The Medical Center of Aurora, Aurora, Colorado

¹²Department of Emergency Medicine, Presbyterian / St. Lukes Medical Center, Denver, Colorado

¹³Department of Emergency Medicine, Lutheran Medical Center, Wheatridge, Colorado

¹⁴Department of Pharmacy, Saint Joseph Hospital, Denver, Colorado

Abstract

Objectives—The annual incidence of out-of-hospital cardiac arrest (CA) in the United States is approximately 6 per 10,000 population and survival remains low. Relatively little is known about the performance characteristics of a two-tiered EMS system split between fire-based basic life support dispersed from fixed locations and hospital-based advanced life support dispersed from non-fixed locations. The objectives of this study were to, therefore, describe the incidence of CA in Denver, Colorado and to define the prevalence of survival with good neurological function in the context of this EMS system.

Methods—*Setting:* A two-tiered hospital-based EMS system for the County of Denver, and 10 receiving hospitals. *Population:* Consecutive adult patients who experienced non-traumatic out-of-hospital CA from January 1, 2003 through December 31, 2004. *Design:* Retrospective cohort

Address for Correspondence: Jason S. Haukoos, MD, MSc Department of Emergency Medicine Denver Health Medical Center 777 Bannock Street, Mail Code 0108 Denver, Colorado 80204 USA Tel: (303) 436-7141 Fax: (303) 436-7541 jason.haukoos@dhha.org. For the Colorado Cardiac Arrest & Resuscitation Collaborative Study Group and the Denver Metro EMS Medical Directors

Presented, in part, at the Society for Academic Emergency Medicine (SAEM) Annual Meeting, Washington, D.C., May, 2008.

study using standardized abstraction methodology. *Data Collection:* Demographic and prehospital arrest characteristics and treatment data, and survival data using the Utstein template. *Outcome:* Good neurologic survival defined by a Cerebral Performance Category (CPC) Score of 1 or 2.

Results—During the study period, 1,985 arrests occurred. Of these, 715 (36%) had attempted resuscitation by paramedics and constitute our study sample. The median age was 65 (IQR: 52–78) years, 69% were male, 41% had witnessed arrest, 25% had bystander CPR performed, and 30% had VF or pulseless VT as their initial rhythm. Of the 715 patients, 545 (76%) were transported to a hospital, 223 (31%) had return of spontaneous circulation, 175 (25%) survived to hospital admission, 58 (8%) survived to hospital discharge, and 42 (6%, 95% CI: 4%–8%) had a good neurologic outcome.

Conclusions—Out-of-hospital CA survival in Denver, Colorado is similar to other United States communities.

Keywords

cardiac arrest; epidemiology; incidence; survival; neurologic survival; emergency medical services; prehospital

INTRODUCTION

Out-of-hospital cardiac arrest (CA) is a major public health problem in the United States and around the world. Recent data suggest at least 265,000 people experience an out-of-hospital CA in the United States each year.^{1–3} Despite considerable attention and efforts to improve the treatment of cardiac arrest, overall survival rates remain low and have not improved in contrast to the decline in morbidity and mortality observed for most cardiovascular diseases.⁴ Survival following out-of-hospital CA is largely dependent on the performance and quality of cardiopulmonary resuscitation (CPR) and early defibrillation, much of which may be influenced by emergency medical services (EMS) systems.⁵ However, debate continues as to whether early advanced care, including intravenous drugs, improves survival in sudden cardiac arrest.⁶ While overall survival rates for out-of-hospital CA are low, there is significant regional variation.^{2,7} Published reports indicate survival varies from as low as 0% to as high as 46%, depending on the region and how cardiac arrest survival is defined.⁸

Survival to hospital discharge following out-of-hospital CA is one of a number of endpoints used for performance evaluation and comparison of EMS systems, as well as for determining the impact of new interventions in basic and advanced life support. Relatively little is known, however, regarding the overall survival rates of out-of-hospital cardiac arrest in metropolitan settings that use a two-tiered approach with a fire-based first response from fixed locations and a hospital-based paramedic second response using a dynamic dispersal system.

Therefore, the primary objectives of this study were to report the incidence of adult non-traumatic CA, and the proportions of return of spontaneous circulation (ROSC), survival to hospital admission (SHA), survival to hospital discharge (SHD), and SHD with good neurologic function for the County of Denver, Colorado in the context of our EMS system. A second, exploratory objective included evaluating associations of patient and arrest characteristics with SHD and SHD with good neurological function in order to improve our understanding of which characteristics were likely associated with survival in this setting.

METHODS

This study was approved by the institutional review boards of all 10 participating institutions and met criteria and received approval for exemption from informed consent and HIPAA authorization in all instances.

Study Design

This was a secondary analysis of the Denver Cardiac Arrest Registry. This registry includes consecutive adult patients who experienced non-traumatic out-of-hospital cardiac arrest in Denver, Colorado. The registry was originally developed to estimate the incidence and proportion of survivors of adult, out-of-hospital cardiac arrest for the county of Denver.⁹

Study Population and Setting

The study population included consecutive adult (age ≥ 18 years) patients who experienced non-traumatic out-of-hospital cardiac arrest in Denver County from January 1, 2003 through December 31, 2004. Denver County has a geographic area of approximately 150 square miles, and has an estimated county population of 550,000 and an estimated metropolitan population of 2.3 million according to 2006 census data.¹⁰

Prehospital medical care in Denver consists of a two-tiered response system using fixed and dynamic dispersal. Fire-based first responders are dispersed from fixed locations and provide BLS, including use of automated external defibrillators (AEDs). Hospital-based second responders are dispersed from non-fixed locations and provide ALS. The Denver Health Paramedic Division is the primary ALS agency, responding to approximately 80,000 calls for emergency medical assistance annually, which accounts for approximately 97% of all calls in Denver. Although paramedics follow the American Heart Association's ACLS Guidelines for performing ALS, they primarily use clinical judgment when determining whether to initiate resuscitation. Patients are transported to one of 10 acute-care adult receiving hospitals in Denver, and all 10 hospitals participated in this study. Between 2003 and 2004, two of the 10 hospitals were academic medical centers, three served as level 1 trauma centers, and eight functioned as cardiac care referral centers. The median annual ED census of these hospitals was approximately 49,000 (range: 17,000 – 72,000).

Data Collection

The Denver Cardiac Arrest Registry was developed using standardized retrospective data collection methodology.¹¹ Consecutive cardiac arrest patients were identified from the electronic Denver Paramedic response database, which includes all data collected during the prehospital patient encounter for all patients responded to by Denver Paramedics. Beginning in December 2002, all prehospital data were collected using portable laptop computers (Panasonic Toughbook, Panasonic Corporation, Secaucus, NJ) and electronic data entry, storage, and maintenance (HealthWare Solutions EMS Software, HealthWare Solutions, Arcata, CA). All prehospital patient and arrest characteristics were collected prospectively and in real-time by the paramedics.

In order to capture all cardiac arrest patients during the study period and to populate the registry, several database search strategies were performed. Patients were initially identified if they had any of the following: (1) a paramedic diagnosis of "cardiac arrest"; (2) use of epinephrine; (3) performance of basic or advanced airway techniques (e.g., bag valve mask ventilation or intubation); (4) performance of CPR or defibrillation; or (5) absent vital signs. Trained research assistants examined each record to confirm the presence of cardiac arrest prior to final inclusion in the registry. Patients were excluded if they experienced trauma resulting in arrest or were < 18 years old.

Prehospital data were transferred into the registry, including each patient's name and demographics (i.e., date of birth, sex, race/ethnicity), the location of the arrest, whether the arrest was witnessed by a bystander or EMS personnel, whether bystander CPR was performed, the initial arrest rhythm, whether defibrillation was attempted, and the paramedic response interval (defined as the time from assignment of an ambulance following the 911 call to arrival at the scene) (in minutes).

A closed-response data collection instrument was used to collect data for each patient. The instrument included the prehospital data as well as ROSC, survival to hospital admission (SHA), SHD, and the Cerebral Performance Categories (CPC) Scale score at the time of discharge. The CPC Scale score was chosen because of its utilization in the Utstein template.¹² All prehospital data were confirmed or corrected by trained research assistants using a standardized review process of all paramedic response records. Survival data were obtained using standardized medical record abstraction from each receiving hospital by trained physician abstractors or research assistants. All abstractors were blinded to the purpose of this study.

Outcome Measures

The primary outcome measure for this study was SHD with good neurological function as defined by a CPC Scale score of 1 or 2. This level of neurological function is consistent with sufficient cerebral function for independent activities of daily life.¹³ Because survival data were abstracted retrospectively by evaluating medical records and because CPC Scale scores were not routinely documented in the records, abstractors were specifically trained to estimate CPC Scale scores based on the patient's neurological condition at the time of discharge.

All abstractors were clinicians trained using a standardized approach by the principal investigator. Instructions related to the abstraction of the patient's neurological condition at the time of discharge were developed, tested, and refined prior to their implementation. Two blinded abstractors were used to assess the validity (using abstraction performed by the principal investigator as the criterion standard) and reliability of the abstraction method using subjects from two of the hospitals (Denver Health Medical Center and the University of Colorado Hospital). Once this was complete, each abstractor from the other eight sites was provided written and verbal instructions related to the abstraction of this outcome. No additional validity or reliability assessments were performed, although abstractors were able to contact the principal investigator for clarification during chart review.

Data Management and Statistical Analyses

All data were either electronically transferred or manually entered into an electronic database (Microsoft Access, Microsoft Corporation, Redmond, WA). The dataset was cleaned and de-identified, and all data were transferred into native SAS or Stata formats using translational software (dfPower DBMS/Copy, DataFlux Corporation, Cary, NC). All statistical analyses were performed using SAS Version 9.2 (SAS Institute, Inc., Cary, NC) or Stata Version 10 (Stata Corporation, College Station, TX).

Descriptive analyses were performed on all variables. The incidence of cardiac arrest was estimated using the total number of arrests as the numerator and both county and metropolitan population estimates as the denominator. Both population estimates were used in order to account for variation of the population within the County of Denver given that a large but undefined number of people commute into the county from surrounding metropolitan areas. Proportions are reported as percentages and 95% confidence intervals (CIs) for each outcome. Weighted kappa, using equal weights between categories of the

CPC Scale, was used to assess outcome reliability. As part of our secondary goals, bivariate tests of association were performed and odds ratios and 95% CIs are reported for patient and arrest characteristics and SHD and SHD with good neurological function. No adjustments were made for multiple statistical comparisons.

Sample Size

The sample size was calculated in order to report a 95% CI of 5% or less for the proportion of patients who SHD. Estimating that 350 patients with attempted resuscitation occur each year in Denver, we estimated requiring at least 700 patients for this study.

RESULTS

During the study period, 1,985 adult patients experienced non-traumatic out-of-hospital cardiac arrest. Of these, 715 (36%) had attempted resuscitation by paramedics, and this group represents our study sample. The median age was 65 (IQR: 52 – 78) years and 69% were male. In addition, 41% were witnessed by bystanders, 8% were witnessed by EMS personnel, 25% received bystander CPR, and 30% had VF or pulseless VT as their initial identified rhythms.

The estimated incidence of out-of-hospital cardiac arrest during the two-year study period ranged from 4.1 to 18.5 per 10,000 population (Table 1). The population at risk varies depending on the actual number of people within the county, and because this is unknown, the true incidence likely falls between these two estimates. Of the 715 patients, 545 (76%) were transported to a hospital, and 223 (31%, 95% CI: 28%–35%) had ROSC, 175 (25%, 95% CI: 21%–28%) SHA, 58 (8%, 95% CI: 6%–10%) SHD, and 42 (6%, 95% CI: 4%–8%) SHD with good neurological function. Overall raw agreement for determining good neurological function was 80%, and the weighted kappa for assessing neurological function was 0.83.

Of the 715 patients, 123 (17%) had a witnessed arrest with an initial rhythm of VF or pulseless VT. Of these patients, 64 (52%, 95% CI: 43%–61%) had ROSC, 56 (46%, 95% CI: 37%–55%) had SHA, 33 (27%, 95% CI: 19%–36%) had SHD, and 23 (19%, 95% CI: 12%–27%) had SHD with good neurological function.

Age, whether the arrest was witnessed, the initial arrest rhythm, defibrillation, use of an automated external defibrillator, and a lower total dose of epinephrine administered were statistically associated with SHD (Table 2). Conversely, sex, whether bystander CPR was performed, and paramedic response interval were not statistically associated with SHD.

Age, whether the arrest was witnessed, the initial arrest rhythm, defibrillation, use of an automated external defibrillator, and a lower total dose of epinephrine administered were statistically associated with good neurological SHD (Table 3). Conversely, sex, whether bystander CPR was performed, and paramedic response interval were not statistically associated with good neurological SHD.

DISCUSSION

Survival with good neurological function following out-of-hospital CA requires a well coordinated approach to care, including citizen awareness, early access to CPR, defibrillation, and EMS, and optimal emergency department and post-resuscitation care.^{12, 14–22} Unfortunately, survival with good neurological function remains uncommon and understanding the epidemiology of cardiac arrest in specific communities, as in Denver, represents the first step in identifying ways to improve survival.

The results of this study demonstrate similar survival outcomes relative to other metropolitan communities in North America, and support utilization of a two-tiered EMS system split between fire-based BLS and hospital-based ALS. In addition, our system is relatively unique in that it uses fixed dispersal for BLS and dynamic dispersal for ALS, and the results of this study, to our knowledge, represents the first description of cardiac arrest survival using this type of system.

Two articles published in the 1990s provided insight into how different EMS systems impact survival following out-of-hospital CA, and both reported large variations in survival across several distinct EMS systems.^{23, 24} Both reviews classified EMS systems into one of five mutually exclusive systems using tiered response (one or two) and the level of training of the responders (basic emergency medical technicians (EMT), basic EMTs trained to use defibrillators, or paramedics). In both instances, the authors concluded that survival was greater in systems that used a two-tiered, BLS/ALS approach. Unfortunately, additional operational details of each EMS system were not provided in these reviews, making it difficult to know whether there are differences between fire- or non-fire-based systems or whether different dispersal mechanisms influence outcomes.

More recently, Persse *et al.* reported the results of a study to compare survival following out-of-hospital CA due to VF between a uniform, “all ALS”, deployment strategy and a tiered deployment strategy within the same fire-based EMS system.²⁵ Their study provided additional operational details related to deployment and how it may impact survival, although their EMS system was not split as it is with our system. The different cardiac arrest survival rates from other communities include a variety of EMS system structures that may influence survival.^{2,7,8} Unfortunately, it still remains unknown to what extent, if any, unique system differences, beyond the tiered approach, impact cardiac arrest survival.^{2,7,8}

The characteristics of the population of cardiac arrest victims in Denver are comparable to those reported nationally.²⁶ The annual incidence of out-of-hospital CA in North America ranges from approximately 5 to 20 per 10,000 (4 to 18 per 10,000 in Denver), and it is estimated that between 24% and 53% of all CAs are treated by EMS in North America (36% in Denver),²⁶ between 20% and 38% of all arrests are due to VF or pVT (29% in Denver),²⁷ approximately 27% receive bystander CPR (25% in Denver),³ and SHD in unselected adult populations is approximately 6% (8% in Denver).^{3, 6}

Although the lack of uniformity in reporting arrest characteristics and survival makes comparisons to other published reports difficult, our findings of 27% SHD and 19% SHD with good neurologic recovery in patients with witnessed VF or pulseless VT also compare similarly to other communities as well.²⁸ These findings, however, offer opportunities for focused efforts to further improve survival,²⁹ including but not limited to the incorporation of “CPR First”,^{30, 31} “cardiocerebral” resuscitation strategies,²¹ early aggressive interventions in the emergency department,^{32, 33} implementation of standardized goal-directed post-resuscitation care^{15, 19} and therapeutic hypothermia.^{20, 34} During the study period, none of these potential strategies had been implemented in Denver.

Efforts to improve the timing and methods of delivery of CPR and defibrillation may also improve outcomes. Given the importance of CPR as a simple intervention with demonstrated efficacy, the small proportion of patients who received bystander CPR (26%) in our cohort, while similar to other large metropolitan communities, is disappointing, and further community-wide efforts to improve identification and bystander CPR are warranted.^{2, 35–38}

Novel approaches to performing CPR and defibrillation have been recently described. Investigators in Seattle noted a survival increase among patients with VF following a CPR-

defibrillation protocol change in 2005 that decreased the interval from shock to CPR and increased the duration of CPR between rhythm analyses.^{39,40} Additionally, survival increased following the introduction of a minimally-interrupted cardiac resuscitation protocol in Arizona that emphasized primarily fewer interruptions in CPR.²² Training and continuous education in the performance of CPR and defibrillation for both first responders and paramedics may therefore further improve survival. In 2005, a protocol emphasizing uninterrupted CPR and CPR prior to defibrillation among patients with unwitnessed cardiac arrest was initiated in Denver. Results of this current evaluation provide the basis to compare the introduction of these new interventions on survival.

Training the public in CPR may be another method of improving survival, although the focus of these efforts remains a source of considerable debate.⁴¹ Although there are reports of successful school-based CPR training programs,⁴² some authors have suggested more focused CPR training strategies may be more cost-effective.^{43–45} Specific suggestions have focused on training high risk house-hold companions, the elderly, and those in specific occupations rather than mass training of unselected laypersons. It still remains unclear, however, how best to provide layperson CPR training in large communities in an effort to maximize survival.

Early access to defibrillation represents another critical “link” in the metaphorical chain of survival. Equipping Denver Fire first-responders with automated external defibrillators (AEDs) was initiated in 1996 and since 2000 all first-responding units in Denver have had defibrillation capabilities. Previous reports of equipping non-medical personnel (e.g., police officers, casino security officers, etc.) with AEDs, which resulted in the delivery of first defibrillation in a relatively short period of time, revealed a relatively high survival to hospital discharge percentage.^{46,47} A recent meta-analysis also demonstrated that programs based on CPR plus early defibrillation with AEDs by trained non-healthcare professionals offer a significant survival advantage over CPR alone.⁴⁸ These results substantiate the importance of further improving access to these critical interventions; however, effective and efficient implementation of such resources have not yet been clearly delineated and are likely community-specific.

Improving access to hospital-based medical services and post-resuscitative care may represent other opportunities to improve survival from CA. A recent commentary described the community as an important, powerful, and underappreciated factor in determining survival after cardiac arrest.⁸ As these authors pointed out, reporting of cardiac arrest survival statistics as we have done in this study may bring us closer to identifying and improving geographic variation in CA survival. There may be no single answer to improving cardiac arrest survival for all communities, although there are areas that deserve focus when attempting to maximize survival from CA. Each community may need to focus efforts and resources in somewhat different ways to achieve optimal success.

LIMITATIONS

The results of this study should be interpreted in the context of several potential limitations. While the Utstein template designates inclusion of only those patients for whom attempted resuscitation occurs, it is possible that a small number of patients for whom resuscitation was not performed should have been included in our study sample. Paramedic judgment regarding when to initiate resuscitation was required, and while variation exists between paramedics, they were all trained to follow specific advanced cardiac life support protocols.

Additionally it is possible that despite efforts to capture all non-traumatic adult cardiac arrests that occurred during the study period, our method of case identification may have

resulted in selection bias. This potential bias was minimized by the use of broad search criteria and systematic review of all patient records prior to inclusion in the registry.

Misclassification bias of the outcomes may have also occurred, although all outcome abstraction was performed by trained clinicians using standardized data abstraction methodology. We also did not attempt to assess the effect of hospital-based post-resuscitation care on outcomes. There may have been variation among receiving hospitals with respect to interventions, including the use of percutaneous coronary intervention, that may have influenced relative survival.

Finally, the statistical comparisons between patient and arrest characteristics and survival should be interpreted as preliminary. They are reported as multiple bivariate associations without adjusting for multiple comparisons. Additionally, no multivariable modeling was performed due to the small number of outcomes.

CONCLUSIONS

Out-of-hospital CA survival in Denver, Colorado is similar to other United States communities. This finding provides the basis for future epidemiological and health services research in the out-of-hospital and ED settings in our community.

Acknowledgments

The authors would like to thank Maria Kinsella, RN, BSN from Exempla Saint Joseph Hospital for help with data abstraction. We also would like to thank all the Denver firefighters and Denver Health paramedics for their tireless and outstanding approach to the care of patients who experience out-of-hospital cardiac arrest, and to those who staff the emergency departments and intensive care units in each of the hospitals included in this project.

Supported, in part, by an Independent Scientist Award (K02 HS017526) from the Agency for Healthcare Research and Quality (Haukoos).

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Table 1

Estimated incidence of adult non-traumatic out-of-hospital cardiac arrest in Denver, Colorado.

2003	Number	Incidence[§]
Denver Metro Population Estimate [*]	2,229,879	4.5
Denver County Population Estimate [†]	555,997	18.5
Cardiac Arrests [‡]	1,027	-
2004		
Denver Metro Population Estimate [*]	2,326,126	4.1
Denver County Population Estimate [†]	555,836	17.2
Cardiac Arrests [‡]	958	-

^{*} Annual estimates of the population of metropolitan and micropolitan statistical areas: April 1, 2000 to July 1, 2006. Accessed at: <http://www.census.gov/population/www/estimates/metro-general/2006/CBSA-EST2006-02.csv>.

[†] County total population, population change and estimated components of population change: April 1, 2000 to July 1, 2006. Accessed at: <http://www.census.gov/popest/counties/files/COEST2006-ALLDATA.csv>.

[‡] Defined by all patients who experienced out-of-hospital cardiac arrest for which Denver Paramedics responded to the scene (excludes trauma and pediatrics (defined by an age < 18 years old)).

[§] Per 10,000 population.

Table 2

Patient characteristics and bivariate associations with survival to hospital discharge following out-of-hospital cardiac arrest.

Variables	Survival to Hospital Discharge				OR	(95% CI)
	Yes	No	Total			
Age (years)	58 (46–71)	66 (52–78)	65 (52–78)	0.98 (0.97–1.0)		
Male Sex	42/58 (72%)	450/655 (69%)	492/713 (69%)	1.2 (0.7–2.2)		
Initial Rhythm						
VF/pVT	43/51 (84%)	166/646 (26%)	209/697 (30%)	39.5 (9.4–165.1)		
PEA	6/51 (12%)	175/646 (27%)	181/697 (26%)	5.2 (1.0–26.2)		
Asystole	2/51 (4%)	305/646 (47%)	307/697 (44%)			
Witnessed Arrest						
Yes	41/58 (71%)	250/657 (38%)	291/715 (41%)	7.4 (3.4–16.0)		
Paramedic	9/58 (16%)	48/657 (7%)	57/715 (8%)	8.4 (3.1–22.9)		
No	8/58 (14%)	359/657 (55%)	367/715 (51%)			
Bystander CPR						
Yes	19/58 (33%)	162/657 (25%)	181/715 (25%)	1.5 (0.8–2.7)		
No	39/58 (67%)	495/657 (75%)	534/715 (75%)			
Defibrillation						
Yes	45/58 (78%)	257/655 (39%)	302/713 (42%)	5.4 (2.8–10.1)		
No	13/58 (22%)	398/655 (61%)	411/713 (58%)			
AED						
Yes	16/58 (28%)	53/657 (8%)	69/715 (10%)	4.3 (2.3–8.2)		
No	42/58 (72%)	604/657 (92%)	646/715 (90%)			
Total Epinephrine (mg)	1 (1–2)	2 (2–3)	2 (1–3)	0.5 (0.3–0.8)		
Response Interval (min.)	6 (4–9)	5 (4–7)	5 (4–8)	1.1 (1.0–1.2)		

Abbreviations: OR = odds ratio; CI = confidence interval; PEA = pulseless electrical activity; VF/pVT = ventricular fibrillation/pulseless ventricular tachycardia; CPR = cardiopulmonary resuscitation; AED = automated external defibrillation; mg = milligram; min. = minutes.

Continuous data are reported as medians and interquartile ranges. Denominators vary due to missing data.

Patient characteristics and bivariate associations with survival to hospital discharge with good neurologic function following out-of-hospital cardiac arrest.

Table 3

Variables	Good Neurological Survival*				OR	95% CI
	Yes	No	Total			
Age (years)	55 (45–66)	66 (52–78)	65 (52–78)	0.97 (0.95–0.99)		
Male Sex	32/42 (76%)	460/671 (69%)	492/713 (69%)	1.4 (0.7–2.9)		
Initial Rhythm						
VF/pVT	32/38 (84%)	177/659 (27%)	209/697 (30%)	27.6 (6.5–116.4)		
PEA	4/38 (11%)	177/659 (27%)	181/697 (26%)	3.4 (0.6–19.0)		
Asystole	2/38 (5%)	305/659 (46%)	307/697 (44%)			
Witnessed Arrest						
Yes	28/42 (67%)	263/673 (39%)	291/715 (41%)	6.4 (2.6–15.7)		
Paramedic	8/42 (19%)	49/673 (7%)	57/715 (8%)	9.8 (3.3–29.5)		
No	6/42 (14%)	361/673 (54%)	367/715 (51%)			
Bystander CPR						
Yes	12/42 (29%)	169/673 (25%)	181/715 (25%)	1.2 (0.6–2.4)		
No	30/42 (71%)	504/673 (75%)	534/715 (75%)			
Defibrillation						
Yes	31/42 (74%)	271/671 (40%)	302/713 (42%)	4.2 (2.1–8.4)		
No	11/42 (26%)	400/671 (60%)	411/713 (58%)			
AED						
Yes	8/42 (19%)	61/673 (9%)	69/715 (10%)	2.4 (1.1–5.3)		
No	34/42 (81%)	612/673 (91%)	646/715 (90%)			
Total Epinephrine (mg)	1 (1–2)	2 (2–3)	2 (2–3)	0.2 (0.1–0.6)		
Response Interval (min.)	6 (4–9)	6 (4–8)	6 (4–8)	1.0 (0.9–1.1)		

Abbreviations: OR = odds ratio; CI = confidence interval; PEA = pulseless electrical activity; VF/pVT = ventricular fibrillation/pulseless ventricular tachycardia; CPR = cardiopulmonary resuscitation; AED = automated external defibrillation; mg = milligram; min. = minutes.

Continuous data are reported as medians and interquartile ranges. Denominators vary due to missing data.

* Good neurological survival is defined as survival to hospital discharge with a Cerebral Performance Category (CPC) Scale score of 1 or 2.