Cardiac Arrest Survival in Pediatric and General Emergency Departments

Kenneth A. Michelson, MD, MPH,[a] Joel D. Hudgins, MD,[a] Michael C. Monuteaux, ScD,[a] Richard G. Bachur, MD,[a] Jonathan A. Finkelstein, MD, MPH[b]

abstract

BACKGROUND AND OBJECTIVES: Pediatric out-of-hospital cardiac arrest (OHCA) has a low rate of survival to hospital discharge. Understanding whether pediatric emergency departments (EDs) have higher survival than general EDs may help identify ways to improve care for all patients with OHCA. We sought to determine if OHCA survival differs between pediatric and general EDs.

METHODS: We used the 2009–2014 Nationwide Emergency Department Sample to study children under 18 with cardiac arrest. We compared pediatric EDs (those with >75% pediatric visits) to general EDs on the outcome of survival to hospital discharge or transfer. We determined unadjusted and adjusted survival, accounting for age, region, and injury severity. Analyses were stratified by nontraumatic versus traumatic cause.

RESULTS: The incidences of nontraumatic and traumatic OHCA were 7.91 (95% confidence interval [CI]: 7.52–8.30) and 2.67 (95% CI: 2.49–2.85) per 100 000 person years. In nontraumatic OHCA, unadjusted survival was higher in pediatric EDs than general EDs (33.8% vs 18.9%, $P < .001$). The adjusted odds ratio of survival in pediatric versus general EDs was 2.2 (95% CI: 1.7–2.8). Children with traumatic OHCA had similar survival in pediatric and general EDs (31.7% vs 26.1%, $P = .14$; adjusted odds ratio = 1.3 [95% CI: 0.8–2.1]).

CONCLUSIONS: In a nationally representative sample, survival from nontraumatic OHCA was higher in pediatric EDs than general EDs. Survival did not differ in traumatic OHCA. Identifying the features of pediatric ED OHCA care leading to higher survival could be translated into improved survival for children nationally.

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Divisions of [a]Emergency Medicine and [b]General Pediatrics, Boston Children's Hospital, Boston, Massachusetts

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Address correspondence to Kenneth A. Michelson, MD, MPH, Division of Emergency Medicine, Boston Children's Hospital, 300 Longwood Ave, BCH 3066, Boston, MA 02115. E-mail: kenneth.michelson@childrens.harvard.edu

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WHAT'S KNOWN ON THIS SUBJECT: Survival is poor in pediatric out-of-hospital cardiac arrest. Children with in-hospital cardiac arrest have higher survival in pediatric hospitals compared with nonpediatric hospitals.

WHAT THIS STUDY ADDS: After presenting with nontraumatic out-of-hospital cardiac arrest, children who visited pediatric emergency departments had 33.8% survival to discharge or transfer, compared with 18.9% of those who visited general emergency departments. There was no difference in outcomes among those with traumatic cardiac arrest.

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Pediatric out-of-hospital cardiac arrest (OHCA) occurs in ~2 to 8 children per 100 000 person years, with 6% to 27% surviving to hospital discharge.[1–6] Although the survival rate is higher in traumatic OHCA than in nontraumatic cases, the proportion surviving to hospital discharge remains low.[3,7] Despite improvements in regional care and treatment algorithms for cardiac arrest, survival has not improved over the last decade.[4] Children with both in-hospital cardiac arrest and OHCA have been shown in some studies to have improved outcomes at pediatric hospitals.[8–10] However, it is unclear if the improved outcomes are due to significant differences between patients presenting to pediatric versus general emergency departments (EDs). In addition, because care differs between traumatic and nontraumatic OHCA, ED type may have a differential influence on survival by cause. The low incidence of OHCA makes investigation of these issues possible only with large data sources.

Investigating which care settings have the highest survival would allow for a better understanding of modifiable determinants of survival and would potentially guide interventions to improve outcomes. We compared survival to hospital discharge in traumatic and nontraumatic OHCA among a large, representative cross-section of US children. We hypothesized that OHCA survival would be higher in pediatric EDs.

METHODS

Study Design

We conducted a retrospective cohort study of children presenting to an ED for cardiac arrest. The institutional review board declared this study exempt from review.

Data Source

We used the Nationwide Emergency Department Sample (NEDS), a stratified single-stage cluster sample of ED visits across 947 hospitals in 33 states and the District of Columbia.[11] NEDS is the largest all-payer ED database in the nation and is sponsored by the Agency for Healthcare Research and Quality through a public-private partnership. Each year, more than 30 million ED visits are sampled, capturing ~20% of all ED visits nationally. The sample is stratified by geographic region, teaching hospital status, trauma center, urban or rural location, and hospital ownership. This sampling strategy allows for accurate and precise national estimates of frequencies, weighted to the denominator of 135 million ED visits. Because of this design, analyses in which raw counts of those sampled are used are invalid and would not reflect the general population. Patient demographics, *International Classification of Diseases, Ninth Revision* (ICD-9) diagnoses, injury characteristics, ED disposition, and hospital characteristics are well recorded in NEDS. However, transfer status and clinical variables such as prehospital treatments and presenting cardiac rhythm are unavailable.

Inclusion and Exclusion Criteria

OHCA patients were children under 18 presenting to an ED in the United States between 2009 and 2014 with any diagnosis of cardiac arrest (ICD-9 code 427.5).[12] We used the term OHCA in this study because in-hospital cardiac arrest is rare among children in EDs.[13] We excluded patients with missing outcome data or who were discharged alive from the ED; as such, patients were unlikely to have experienced a cardiac arrest. Exclusions were specified before data analysis.

Outcomes

The primary outcome was survival to hospital discharge or transfer. Secondary outcomes were survival after hospitalization, ED disposition (admitted or transferred), critical care interventions, and survival and length of stay among hospitalized patients.

Definition of ED Type

The primary independent variable was ED type, classified as either a pediatric or general ED. A pediatric ED was defined as having more than 75% ED visits by patients under 18 years of age.[14,15] Of the hospitals sampled in the NEDS, 99.9% have either <49% or >96% pediatric visits, providing a means of identifying hospitals that care exclusively for children.

Covariates

We analyzed patient age, sex, primary insurance payer, presentation on a weekend, and US census region as possible confounders of the relationship between ED type and survival. To assess socioeconomic status, we used the median income for each patient's zip code, stratified into quartiles. The cut points between the annual income quartiles ranged from year to year as follows: poorest to second quartile (annual range: $38 000–$41 000), second to third quartile ($48 000–$51 000), third quartile to wealthiest ($63 000–$67 000). Classification as a teaching hospital was based on NEDS criteria: an American Medical Association-approved residency program, membership with the Council of Teaching Hospitals, or residents/beds ratio of at least 0.25.[16] Trauma designation, awarded by the American College of Surgeons on the basis of trauma resources, personnel, and experience, was recorded in NEDS. Level 1 trauma centers have the highest trauma capability, including 24-hour in-house surgical coverage, prompt availability of subspecialists, and regional leadership.[17]

OHCA cases were identified as nontraumatic or traumatic by presence of any injury diagnosis.[18] Among traumatic OHCA cases, we used the injury severity score, ranging from 1 to 75, with higher values representing more severe injury.[19]

Main Analyses

OHCA incidence was the weighted number of OHCA cases divided by the total number of person years for individuals under the age of 18 years in the US census.[20,21] There were 443 million at-risk person years between 2009 and 2014.

We compared the frequency of traumatic OHCA injury causes. For children who did not have a primary (first-listed) diagnosis of cardiac arrest, we identified the 10 most common primary diagnoses to assess the validity of including such patients in the study.

We compared survival and disposition by ED type. Because ultimate survival of those transferred from an ED could not be determined, we performed a subanalysis of survival to hospital discharge among nontransferred hospitalized patients. As a proxy for the level of disability among surviving patients, we determined if they were discharged from the hospital, transferred to a skilled nursing facility, or transferred to another short-term hospital at the end of hospitalization.

We compared the types of procedures performed for cardiac arrest by using available *Current Procedural Terminology* (CPT) or ICD-9 procedure codes used previously.[22] We included cardiopulmonary resuscitation (CPR) (CPT 92950 or ICD-9 99.60 or 99.63); central venous catheterization (CPT 36555–36566 or ICD-9 38.97); endotracheal intubation (CPT 31500 or ICD-9 96.04); extracorporeal membrane oxygenation (ECMO) (ICD-9 39.65 or 39.66); hemodialysis (ICD-9 39.95); intraosseous infusion (CPT 36680 or ICD-9 41.92); and mechanical ventilation (CPT 94002–94004 or ICD-9 96.70–96.72).

To determine if other determinants of survival might account for an apparent difference in survival by ED type, we modeled the outcome by using logistic regression. The prespecified independent variables were ED type and known predictors of survival in pediatric OHCA, including age and region.[1,23] We did not include sex or socioeconomic status, because previous researchers have suggested that they are unrelated to survival in OHCA.[2,4,24] The model for injured patients included injury severity score, a negative predictor of survival in trauma.[19]

We investigated whether survival could be moderated by teaching hospital status among noninjured patients, hypothesizing that treatment at a teaching hospital might be associated with a survival advantage for children with OHCA. To determine if local pediatric experience was a moderator of survival, we also compared survival among noninjured children in general EDs by quartile of pediatric volume. The quartile cut points for annualized pediatric volume were 7253, 16 561, and 32 997 pediatric visits per year. Because trauma center designation may be more important than ED type in traumatic OHCA survival, we assessed survival among injured patients by trauma designation.

All analyses were stratified by injury status, because outcomes for traumatic and nontraumatic OHCA are known to differ.[3]

Statistical Approach

NEDS was designed to make valid nationwide estimates.[11] Unweighted estimates are considered invalid. Thus, all NEDS estimates and SEs were calculated by using national weighted values and accounted for sample weighting. For bivariate analyses, we used Wilcoxon rank tests for continuous comparisons and χ^2 tests for categorical comparisons. All P values were 2-sided, and significance was predefined at $\alpha < .05$. Data were analyzed by using R version 3.3.3 (R Foundation, Vienna, Austria) and the R survey package for all NEDS analyses.[25]

RESULTS

There were 36 123 523 raw pediatric observations in the NEDS from 2369 hospitals during the study period. This extrapolated to 161 679 705 weighted pediatric ED visits nationally. Of those, 11 266 raw observations included codes for cardiac arrest, weighted to 51 420 visits nationally. We excluded 247 weighted visits (0.5%) for missing outcome data and a further 4293 (8.3%) for missing ED disposition. The 46 880 analyzed visits were drawn from 22 of 54 (40.7%) freestanding pediatric EDs and 1595 of 4971 (32.1%) general EDs.[26,27]

Sex, primary payer, weekend versus weekday presentation, and injury status were similar between pediatric and general EDs (Table 1). There were more visits to pediatric EDs from children ages 1 to 11 years, from children living in the lowest-income areas, from the Midwest and West regions of the United States, and from those with cooccurring diagnoses of acute respiratory failure, acidosis, and anoxic brain injury, compared with general EDs. General EDs had more visits from children over 11 years of age and from the Northeast and South regions.

The incidences of OHCA among noninjured and injured children were 7.91 (95% confidence interval [CI]: 7.52–8.30) and 2.67 (95% CI 2.49–2.85) per 100 000 person years, respectively.

TABLE 1 Demographics of Children With Cardiac Arrest in Pediatric and General EDs From the NEDS

	General EDs	Pediatric EDs	P
	n = 42 843 (92%), n (%)	n = 4037 (8%), n (%)	
Age (y)			<.001
<1	17 223 (40.2)	1614 (40.0)	
1–11	15 616 (36.4)	1902 (47.1)	
>11	10 004 (23.4)	521 (12.9)	
Girls	17 023 (39.8)	1682 (41.7)	.22
Median income for zip code			.002
Poorest quartile	14 920 (35.6)	1736 (43.4)	
Second quartile	11 901 (28.4)	823 (20.6)	
Third quartile	9203 (22.0)	923 (23.1)	
Wealthiest quartile	5897 (14.1)	515 (12.9)	
Primary payer			.14
Medicaid	22 724 (53.1)	2383 (59.1)	
Private	12 252 (28.6)	1131 (28.1)	
Self-pay	5806 (13.6)	349 (8.6)	
Other	1988 (4.6)	170 (4.2)	
Weekend presentation	13 170 (30.7)	1158 (28.7)	.29
US region			<.001
Northeast	6020 (14.1)	69 (1.7)	
Midwest	9093 (21.2)	1702 (42.1)	
South	19 033 (44.4)	878 (21.8)	
West	8698 (20.3)	1389 (34.4)	
Hospital teaching status			<.001
Metropolitan teaching	20 719 (48.4)	4023 (99.6)	
Metropolitan nonteaching	15 325 (35.8)	15 (0.4)	
Nonmetropolitan	6799 (15.9)	0	
Any injury	10 675 (24.9)	1153 (28.6)	.09
Motor vehicle[a]	2747 (25.7)	200 (17.4)	.05
Drowning[a]	2148 (20.1)	195 (16.9)	.39
Suffocation[a]	1178 (11.0)	139 (12.0)	.72
Firearm[a]	1049 (9.8)	36 (3.1)	.004
Injury severity score, median (IQR)[a]	9 (2–17)	9 (4–18)	.03

Survey-weighted national estimates and *P* values are reported. Numbers do not add to column total because of missing data. IQR, interquartile range.
[a] Comparisons among injured patients.

Among the 11 828 injured patients with OHCA, the 10 most common causes of injury were injury by motor vehicle traffic (24.9%), drowning (19.8%), suffocation (11.1%), firearm (9.2%), poisoning (3.4%), natural or environmental causes (3.2%), fire (2.8%), fall (2.8%), struck by or against a person or object (2.2%), and being cut (1.4%). Injuries did not differ between pediatric and general EDs, except for firearm injuries, which were a cause of injury in 9.8% of general ED and 3.1% of pediatric ED patients ($P = .004$, Table 1). Injured patients at pediatric EDs had higher injury severity scores compared with patients at general EDs (Table 1).

When cardiac arrest was not the primary diagnosis, the most frequent primary diagnoses were drowning and nonfatal submersion (10.4%), acute respiratory failure (9.0%), unspecified septicemia (3.5%), asphyxiation and strangulation (3.2%), respiratory arrest (3.1%), unspecified head injury (2.0%), sudden infant death syndrome (2.0%), ventricular fibrillation (1.3%), anoxic brain damage (1.2%), and child physical abuse (1.1%). No other primary diagnoses occurred in at least 1% of secondary cardiac arrest cases.

Unadjusted survival was higher in children with nontraumatic OHCA who visited pediatric EDs compared with those who visited general EDs (974 of 2884, 33.8% vs 6066 of 32 168, 18.9%; $P < .001$; Table 2). In traumatic OHCA, there was no difference between pediatric and general EDs in survival among children overall or among those surviving to hospitalization in the same facility. In pediatric EDs, more children were hospitalized, fewer were transferred, and fewer died in the ED ($P < .01$ for each comparison). CPR and intraosseous infusions were billed more frequently for children at general EDs, but critical procedures including ECMO, hemodialysis, and mechanical ventilation occurred more frequently in pediatric EDs (Table 2).

Survival at pediatric hospitals was higher in the subgroup of children who were hospitalized at the same facility (59.8% vs 51.3%, $P = .02$). More surviving children were discharged from the hospital and transferred to a rehabilitation facility rather than home when initial care occurred in a general ED as compared with a pediatric ED (13.7% vs 3.6%; Table 2). Among hospitalized patients, CPR, endotracheal intubation, and mechanical ventilation were more frequent in general EDs, whereas ECMO was more common at pediatric hospitals (Table 2).

In the adjusted analysis, children with nontraumatic OHCA who visited pediatric hospitals had higher survival rates than those visiting general EDs after adjusting for age and US region (adjusted odds ratio [aOR]: 2.2, 95% CI: 1.7–2.8, Table 3). Adjusted survival was not different for injured children by ED type (aOR: 1.2, 95% CI: 0.8–1.9). An adjusted model without injury severity did not change the estimate for adjusted survival in traumatic OHCA.

Survival did not differ significantly by teaching hospital status among

TABLE 2 Cardiac Arrest Outcomes and Procedures in Pediatric and General EDs From the NEDS

	Noninjured Children			Injured Children		
	General ED	Pediatric ED	*P*	General ED	Pediatric ED	*P*
All patients, *n* (%)	32 168 (100.0)	2884 (100.0)	—	10 675 (100.0)	1153 (100.0)	—
Survival	6066 (18.9)	974 (33.8)	<.001	2782 (26.1)	366 (31.7)	.14
Disposition			<.001			<.001
Died in ED	24 130 (75.0)	1266 (43.9)		6165 (57.7)	381 (33.1)	
Transferred from ED	3985 (12.4)	19 (0.6)		1686 (15.8)	9 (0.8)	
Hospitalized from ED	4052 (12.6)	1599 (55.5)		2825 (26.5)	762 (66.1)	
Billed procedures						
CPR	17 862 (55.5)	903 (31.3)	<.001	5257 (49.2)	344 (29.8)	<.001
Central venous catheterization	873 (2.7)	146 (5.1)	.13	774 (7.3)	47 (4.1)	.15
ECMO	235 (0.7)	172 (6.0)	<.001	28 (0.3)	37 (3.2)	<.001
Endotracheal intubation	14 282 (44.4)	1210 (41.9)	.59	4672 (43.8)	479 (41.5)	.59
Hemodialysis	87 (0.3)	28 (1.0)	.004	38 (0.4)	11 (1.0)	.14
Intraosseous infusion	1861 (5.8)	79 (2.7)	.04	406 (3.8)	53 (4.6)	.75
Mechanical ventilation	4518 (14.0)	1118 (38.8)	<.001	2864 (26.8)	654 (56.7)	<.001
Hospitalized patients, *n* (%)	4052 (100.0)	1599 (100.0)	—	2825 (100.0)	762 (100.0)	—
Survival, *n* (%)	2081 (51.3)	956 (59.8)	.02	1096 (38.8)	357 (46.8)	.13
Hospital length of stay, d (IQR)						
Patients who survived	15 (5–30)	22 (9–40)	.10	14 (4–29)	18 (6–43)	.06
Patients who died	2 (1–5)	2 (1–7)	.03	1 (1–3)	2 (1–4)	.08
Disposition of survivors, *n* (%)			<.001			<.001
Home	1045 (50.2)	681 (71.3)		496 (45.3)	262 (73.3)	
Short-term hospital	456 (21.9)	45 (4.7)		174 (15.9)	22 (6.3)	
Skilled nursing or intermediate facility	284 (13.7)	44 (4.6)		319 (29.1)	52 (14.7)	
Home health care	296 (14.2)	157 (16.5)		95 (8.7)	11 (3.0)	
Unknown	0	29 (3.0)		11 (1.0)	10 (2.7)	
Billed procedures, *n* (%)						
CPR	1646 (40.6)	417 (26.0)	.004	920 (32.6)	172 (22.6)	.09
Central venous catheterization	345 (8.5)	122 (7.6)	.83	192 (6.8)	41 (5.4)	.61
ECMO	235 (5.8)	172 (10.8)	.02	28 (1.0)	31 (4.1)	.009
Endotracheal intubation	2444 (60.3)	797 (49.8)	.03	1426 (50.5)	345 (45.2)	.27
Hemodialysis	87 (2.2)	28 (1.8)	.64	38 (1.3)	11 (1.5)	.88
Intraosseous infusion	50 (1.2)	15 (0.9)	.68	27 (1.0)	15 (1.9)	.34
Mechanical ventilation	3208 (79.2)	1105 (69.1)	.006	2343 (82.9)	640 (84.0)	.81

IQR, interquartile range; —, not applicable.

TABLE 3 Adjusted Cardiac Arrest Survival, Stratified by Injury

	Noninjured Children	Injured Children
	aOR (95% CI)	aOR (95% CI)
Pediatric ED	2.2 (1.7–2.8)	1.3 (0.8–2.1)
Age (y)		
<1	Reference	Reference
1–11	1.7 (1.4–1.9)	0.5 (0.3–0.7)
≥12	2.2 (1.9–2.6)	0.4 (0.3–0.7)
Region		
Northeast	Reference	Reference
Midwest	1.3 (1.1–1.7)	1.2 (0.7–1.9)
South	1.3 (1.1–1.7)	1.0 (0.6–1.6)
West	1.4 (1.1–1.7)	0.8 (0.5–1.3)
Injury severity (per 10 points)	—	1.11 (1.02–1.21)

Nontraumatic OHCA patient survival was adjusted for age and US region. Traumatic OHCA survival was adjusted for age, US region, and injury severity score. —, not applicable.

nontraumatic OHCA patients at general EDs. Survival was also similar regardless of the quartile of total hospital pediatric volume, with rates from lowest- to highest-volume quartile of 18.0%, 17.9%, 18.8%, and 19.0% (global $P = .91$).

Trauma hospital designation was known in 9595 of 11 828 (81%) injury cases. Among all pediatric OHCA, survival to discharge or transfer was 24.8%, 21.8%, and 30.4% in level 1, 2, and 3 trauma centers, respectively, and 31.1% in nontrauma centers (global $P = .02$). The proportion of patients transferred from each ED type was 1.4%, 11.1%, 26.3%, and 26.8%, respectively (global $P < .001$). Survival to admission or transfer from the ED was 59.8%, 43.0%, 35.9%, and 34.5% among level 1, 2, and 3 trauma centers and nontrauma centers, respectively (global $P < .001$).

DISCUSSION

In this nationally representative sample, more noninjured children with OHCA survived after care in pediatric EDs compared with general EDs, whereas children with injury had similar survival regardless of ED type. Although outcomes of children after transfer could not be determined, a subanalysis of nontransferred children revealed a similar survival difference based on the ED type. Interventions for cardiac arrest differed by ED type: children in pediatric EDs were more likely to undergo ECMO, hemodialysis, and mechanical ventilation and less likely to have CPR or intraosseous infusion procedure codes.

Our observed survival differences may be related to improved emergency or postarrest care at pediatric hospitals. More children received ECMO at pediatric hospitals and fewer received mechanical ventilation, which may be associated with improved survival but could not account fully for the survival difference.[28,29] Because all of the pediatric EDs in this study were urban, reduced emergency medical system response and transport times could also have played a role. In contrast to the findings in previous work, teaching status and pediatric volume alone did not appear to confer a survival advantage.[8,9] Survival differences may also be partially due to an effect of confounding by patient and illness characteristics. Patients who survive to be transferred from general EDs frequently go to pediatric EDs and may represent a less ill subpopulation. However, the authors of previous work suggest that fewer than a quarter of critically ill patients arrive as transfers to academic centers.[9] Lower CPR rates in pediatric EDs may reflect successful resuscitation before arrival, which would be expected to result in higher survival, but differences in coding are also possible. In the adjusted model, the Northeast had worse survival than other regions. The underlying reasons for this are unclear but may relate to regional differences in patient characteristics or care.

We observed no difference in outcomes by ED type among traumatic arrest patients. The management of traumatic cardiac arrest is highly protocolized.[30] Higher-level trauma center designation is assigned to facilities with resources, personnel, and experience with severe trauma and is associated with improved outcomes in adults and children.[17,31] These resources may be more important in determining outcomes than increased experience treating pediatric patients. This is congruent with our observation that survival to hospital discharge or transfer is associated with higher levels of trauma center care.

The strengths of this study are its national representativeness and large numbers of cases on which estimates are based. With this study, we improve on previous nationally representative work, whose authors showed a survival benefit for respiratory or cardiac arrest in teaching hospitals but included only 1 NEDS year, did not focus on pediatric EDs, and included types of arrest with different prognoses.[9]

This study has several limitations. First, there are likely to be significant differences in patients by ED type. These could include differences in chronic comorbidities and arrest etiologies, and therefore in the survivability of OHCA. Pediatric EDs also receive more patients by transfer who already survived a first ED and thus may be less ill. However, transfers make up a small proportion of patients arriving at pediatric EDs.[9] Second, we identified pediatric EDs as those seeing a high proportion of pediatric patients but could not identify facilities with pediatric-specific EDs within larger hospitals. If pediatric personnel and equipment are mediators of survival in OHCA, then these pediatric EDs in general hospitals may have similar survival to EDs within standalone pediatric hospitals. This would tend to decrease our ability to detect a difference in survival between general and pediatric EDs, if 1 existed. Third, we could not account for major known determinants of survival, including the influence of witnessed cardiac arrest, bystander CPR, and initial cardiac rhythm.[13,32] Although these may be important determinants of survival, it is not clear whether they would be associated with ED type and thus may not confound the relationship between ED type and survival. The adjusted model for traumatic OHCA including injury severity suggested a survival advantage with higher injury severity. However, any injury associated with cardiac arrest is likely to be severe, thus making the result difficult to interpret. A model without injury severity also revealed no difference in survival by ED type, suggesting that the severity variable was not important in the context of traumas severe enough to be associated with arrest. Fourth, there are inherent limitations in the NEDS data set, including the use of diagnosis codes to identify patients with OHCA, the possibility of double-counting transferred patients, the presence of few pediatric EDs, an inability to distinguish ED and inpatient procedures in those hospitalized, and the lack of a validation data set with clinical data. Billing codes cannot always be used to accurately identify cardiac arrest, with adult estimates of positive predictive value between 40% and 80%.[33,34] However, these studies are often overinclusive because of the inclusion of diagnoses not always associated with cardiac arrest (eg, ventricular tachycardia). The similar incidence of cardiac arrest in our study and large registries suggests that we were not overinclusive.[2] Billing codes for CPR occurred in less than half of our sample. Billing differences or differences in prehospital rates of return of spontaneous circulation between ED types between pediatric and general EDs could account for some of the difference in frequency. Finally, we could not definitively distinguish in-ED and OHCA, although the incidence of in-ED cardiac arrest is low.[13]

If our results are verified in future studies whose authors use data sources that contain clinical information, it would suggest that the resources and processes of pediatric EDs confer a higher chance of survival on children with cardiac arrest. Ensuring that all children with OHCA receive care from pediatric EDs is neither practical nor advisable, but identifying the key features of pediatric ED care could be translated into improved survival for children wherever they present with OHCA.

CONCLUSIONS

In a nationally representative sample of children with nontraumatic OHCA, survival was higher in pediatric EDs compared with general EDs. Survival did not differ among children with traumatic OHCA.

ABBREVIATIONS

aOR: adjusted odds ratio
CI: confidence interval
CPR: cardiopulmonary resuscitation
CPT: *Current Procedural Terminology*
ECMO: extracorporeal membrane oxygenation
ED: emergency department
ICD-9: International Classification of Diseases, Ninth Revision
NEDS: Nationwide Emergency Department Sample
OHCA: out-of-hospital cardiac arrest

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