Characteristics and Impact of Bystander Cardiopulmonary Resuscitation Following Pediatric Out of Hospital Cardiac Arrest in the United States: A Study from the Cardiac Arrest Registry to Enhance Survival

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Introduction

Bystander cardiopulmonary resuscitation (CPR) is associated with improved outcome in adult out-of-hospital cardiac arrest (OHCA).

There are limited data on the prevalence and impact of bystander CPR on children in the United States:

- 1 in 3 children receive bystander CPR
- 6-8% survive to hospital discharge

In adults, current AHA guidelines recommend compression only CPR for untrained lay rescuers.

In children, conventional CPR with rescue breaths and chest compressions is preferred over compression only CPR.
Hypothesis

Bystander CPR is associated with improved outcome following OHCA in the United States

Characterize compression only CPR in children
Methods

Cardiac Arrest Registry to Enhance Survival (CARES)

Largest OHCA registry in the United States

Goal is to improve the quality of care and outcome of OHCA

Funded by Red Cross, Centers for Disease Control, American Heart Association, Medtronic, Zoll and Emory University
55 communities in 23 states, 13 statewide registries
Covers a catchment area of over 80 million
> 800 emergency medical service agencies, > than 1,300 hospitals
Methods

Inclusion criteria: Age ≤ 18 years of age, OHCA, lay person CPR, January 1, 2013-December 31, 2014

Excluded: Facilities/nursing homes, traumatic arrests, CPR by first responders

Primary Outcome: Neurologically favorable survival Cerebral Performance Category (CPC) at discharge of 1 (no neurologic disability) or 2 (moderate disability)

Unfavorable outcome: CPC 3 (severe disability) or 4 (coma/vegetative state) or death

Secondary Outcome: Survival to hospital discharge
Results

2,176 cardiac arrests

1059 (49%) bystander CPR

61% male

32% white, 29% black and 12% Hispanic

86% occurred at home

93% had a non-shockable rhythm (EMS or AED)

71% received CPR from a family member
What Age Do Arrests Occur in?

![Bar chart showing the percentage of arrests at different ages.](chart.png)

- 47% of arrests occur in children ≤ 1 year old.
- 15% of arrests occur in children 1-5 years old.
- 20% of arrests occur in children 5-10 years old.
- 19% of arrests occur in children 11-<18 years old.
Bystander CPR: Age Comparison

![Bar chart showing age comparison of bystander CPR and no bystander CPR.](chart.png)

- **≤ 1 yr**: Higher number of arrests with bystander CPR.
- **1-5 yrs** and **>5-10 yrs** show a similar number of arrests with and without bystander CPR.
- **11-<18 yrs**: Similar number of arrests with and without bystander CPR.

Statistical significance:
- **p=0.29**
Bystander CPR: Arrest Characteristics

There was no difference in arrests characteristics between the bystander CPR group and the no bystander CPR group

- Home
- Out of home arrests
- Witnessed
- Un-witnessed arrests
- Shockable rhythm
- Non-shockable rhythm
Bystander CPR: Racial Differences

![Bar chart showing the percentage of bystander CPR and no bystander CPR for different racial groups. The chart indicates that 60% of White arrests, 58% of Black arrests, and 56% of Hispanic arrests were due to no bystander CPR, with p < 0.001.]
Survival Outcome

Survival to Hospital Discharge
- Bystander CPR: 14%
- No Bystander CPR: 11%
- p<0.0001

Favorable Neurological Outcome
- Bystander CPR: 11%
- No Bystander CPR: 7%
- p<0.0011

Legend:
- Bystander CPR
- No Bystander CPR
Survival Outcome Infants vs. Non-Infants

OR 2.1 95% CI 1.51-2.93
21

OR 1.95 95% CI 1.36-2.80
17

- Survival to Hospital Discharge ≤1 yr: 5.9% (Infants) vs. 5.5% (Non-Infants), p=0.77
- Favorable Neurological Outcome ≤1 yr: 4.7% (Infants) vs. 4.7% (Non-Infants), p=0.95
- Survival to Hospital Discharge >1-<18 yr: 11% (Infants) vs. <18 yr: 9% (Non-Infants)
In subgroup analysis bystander CPR was associated with improved outcomes in all subgroups including:

- Non-shockable rhythm
- Presumed cardiac arrest
- Presumed non-cardiac
- Out of home
- Home arrests

Notable survival for the following subgroups
Survival Outcome: 11-18 years

OR 2.3 95% CI 1.4-3.7
OR 1.5 95% CI 0.97-2.3

% of Arrests 11-18

Survival to Hospital Discharge
Favorable Neurological Outcome

- Bystander CPR
- No Bystander CPR

28.3
14.8
23.3
13.3
Survival Outcome: Witnessed Arrests

OR 1.9 95% CI 1.3-2.9

OR 1.5 95% CI 0.97-2.3

% of Witnessed Arrests

Survival to Hospital Discharge

Favorable Neurological Outcome

Bystander CPR

No Bystander CPR
Survival Outcome: Out of Home

OR 2.9 95% CI 1.7-4.9

38.5

OR 3.0 95% CI 1.7-5.3

34.2

% of Out of Home Arrests

Survival to Hospital Discharge

Favorable Neurological Outcome

Bystander CPR

No Bystander CPR
Survival Outcome: Shockable Rhythm

OR 2.4 95% CI 1.2-4.6

OR 2.0 95% CI 1.0-3.8

% of Arrests with Shockable Rhythm

- Survival to Hospital Discharge: 31.8%
- Favorable Neurological Outcome: 31.8%

- Bystander CPR
- No Bystander CPR
Type of CPR data available for 80% of arrests

Compression only CPR occurred in 50% of bystander CPR events

There was no significant difference in survival to hospital discharge or favorable neurological outcome although trends in better outcomes were observed for conventional CPR
Multivariable Analysis

To assess the contribution of bystander CPR to outcome

Adjusted for potential confounding factors age, gender, race, witnessed arrest, location, etiology, rhythm and AED use

Bystander CPR was associated with improved survival to hospital discharge (adjusted OR 1.4 95% CI 1.11-2.04, p=0.008)

Borderline significance for favorable neurologic outcome (adjusted OR 1.4 95% CI 0.97=1.89, p=0.074)
Conclusions

Bystander CPR occurs in almost half of pediatric OHCA
- Racial disparities exist in the provision of bystander CPR
- Compression only CPR occurs in 50% of arrests in children

Bystander CPR is associated with improved survival to hospital discharge and favorable neurological outcome, >25% survival was observed

- 11-18 years of age
- Witnessed
- Shockable rhythm
- Out of Home

There was no observed benefit of bystander CPR in infants

Pediatric OHCA survival 11% neurologically favorable outcome 80%
Aknowlegements

Dr. Rossano, CARES, The Children’s Hospital of Philadelphia