



Short paper

Minnesota Heart Safe Communities: Are community-based initiatives increasing pre-ambulance CPR and AED use?



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ARTICLE INFO

Article history:

Received 14 June 2017

Received in revised form 24 July 2017

Accepted 28 July 2017

Keywords:

Out-of-hospital cardiac arrest

Resuscitation

Bystander CPR

AED

Community engagement

ABSTRACT

Aim: Implementation research that describes how successfully resuscitation guidelines are translated into practice are lacking. We examined whether recent community-based initiatives being conducted as part of the Minnesota Heart Safe (HS) Communities program increase the delivery of CPR and use of automated external defibrillators (AED) by bystanders and first responders prior to ambulance arrival.

Methods: Non-EMS witnessed out-of-hospital cardiac arrests (OHCA) with presumed cardiac etiology treated by a single ambulance service in 2013–2015 were studied. Data were obtained from the Minnesota HS program and the Cardiac Arrest Registry to Enhance Survival (CARES) Surveillance Registry. Pre-ambulance CPR and AED use within HS communities before and after completion of the program were compared.

Results: As of July 2016, 17 Minnesota communities within the ambulance service area had achieved HS designation and 294 OHCA events that occurred in these communities met inclusion criteria for analysis (120 before HS designation, 174 after). CPR was initiated by bystanders or first responders prior to ambulance arrival in 83% of OHCA events that occurred before HS designation and in 95% of events that occurred after designation (OR = 4.23 [1.80–9.98]). Pre-ambulance AED use increased from 63% to 77% after the community intervention (OR = 1.94 [1.16–3.24]). Overall unadjusted survival to hospital discharge increased slightly after HS designation, but this difference was not statistically significant (17% vs 20%, $p = 0.32$).

Conclusion: Implementation of the Heart Safe program in communities within our ambulance service area in Minnesota has increased use of CPR and AEDs by bystanders and first responders prior to ambulance arrival.

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Introduction

Approximately 325,000 out-of-hospital cardiac arrests (OHCA) are evaluated by emergency medical services (EMS) in the United States each year, and mortality is typically >90%. [1–3] American Heart Association (AHA) resuscitation guidelines are aligned with the objectives of the chain of survival model for OHCA, i.e. early recognition and EMS activation, early CPR, rapid defibrillation, effective advanced life support, and integrated post-arrest care. Systems of care that extend or strengthen aspects of their systems in accordance with AHA guidelines observe improved outcomes [4,5] but a recent Institute of Medicine report [6] highlights a lack of implementation research that describes how successfully AHA resuscitation guidelines are translated into practice.

The Minnesota Heart Safe Communities program encourages and supports the efforts of individual communities to increase public awareness about cardiac arrest and improve preparedness through activities such as promoting the use of automated external defibrillators (AEDs) and the timely delivery of CPR by lay citizens and first responders. This report examines the early impact of these community-based initiatives on the delivery of CPR and use of AEDs prior to ambulance arrival.

Methods

Setting

This study examines the pre-ambulance care of OHCA events treated by Allina Health Emergency Medical Services (AH-EMS), a private ambulance service that responds to over 100,000 calls annually in 120 communities in Minnesota. AH-EMS treats approximately 550 OHCA events each year, and has submitted data to the Cardiac Arrest Reg-

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Table 1
Snapshot of Minnesota Heart Safe Communities studied^a.

Designated Heart Safe communities in Allina Health EMS service area	
Number	17
Average population	30,586
Median population	22,731
Population Range	1396–86,435
TOTAL Population	519,961
Average time between letter of intent and designation	7.1 months
# of AEDs registered or purchased	1081
# of community members trained in CPR	44,293
% of community members trained in CPR	9%

AED = automated external defibrillator; EMS = emergency medical services.

^a Communities designated through July 2016; population data are from 2015.

istry to Enhance Survival (CARES) Surveillance Registry [7] since 2011. CARES provides access to a robust set of standardized variables and AH-EMS OHCA account for approximately 25% of the events submitted to the Minnesota CARES database annually. At the time of analysis, CARES data were complete for arrests occurring in 2013–2015.

Heart Safe Communities Program

Heart Safe (HS) Communities is a program that aims to increase survival following OHCA through community-based activities that strengthen the chain of survival. The program originated in Massachusetts in 2002 and has grown to include initiatives in 16 states and 3 international locations. To achieve HS designation, communities develop and implement an action plan that addresses key elements of early cardiac arrest care. Community-specific action plans typically include educating citizens about the warning signs and symptoms of cardiac arrest, conducting training sessions on how to perform CPR and use AEDs, registering and mapping existing AEDs, and procuring and placing additional AEDs in strategic public locations or first responder vehicles. To begin the designation process, a representative community entity (e.g. city council), most often in partnership with local law enforcement or emergency responder agencies, submits a letter of intent to their local HS administrator detailing the proposed plan. The community then works to accrue points (“heartbeats”) towards designation through completion of the activities outlined in the plan. Additional details are available in the HS Community Designation Toolkit and Application for Minnesota communities. [8] As of July 2016, 46 Minnesota communities had been designated HS and 20 had designation pending. Within our ambulance service area, 17 communities have achieved HS designation and are the focus of the current analysis. In the communities studied, 1081 AEDs were mapped and/or deployed and CPR training was provided to 44,293 (9%) of community members (Table 1).

Table 2
CPR and AED use among non-EMS witnessed out-of-hospital cardiac arrests in designated Heart Safe communities, before and after designation.

	Before Heart Safe Designation (n = 120)	After Heart Safe Designation (n = 174)	Odds Ratio (95% CI)
Who first initiated CPR?			
Bystander	33% (39)	34% (59)	
First responder	50% (59)	61% (107)	
EMS	17% (20)	5% (8)	
CPR initiated prior to EMS arrival	83%	95%	4.23 (1.80, 9.98)
Who first applied AED?			
Bystander	3% (4)	6% (10)	
First responder	60% (72)	71% (124)	
EMS	37% (44)	23% (40)	
AED applied prior to EMS arrival	63%	77%	1.94 (1.16, 3.24)

CPR = cardiopulmonary resuscitation; AED = automated external defibrillator; EMS = emergency medical services.

Study design

All OHCA treated in the 17 HS communities in 2013–2015 were initially considered for analysis. Unwitnessed arrests, those witnessed by EMS (i.e. occurring after ambulance arrival), arrests with non-cardiac etiology, and events in patients <18 years of age were excluded. The primary analysis was a comparison of pre-ambulance CPR and AED use before and after HS designation.

Data and analysis

HS program data as of July 2016 was obtained from the Minnesota Department of Health. Data included zip codes, city names, date of letter of intent, and date of HS award, and were merged with event date and location from CARES to determine whether each event had occurred before or after HS designation. Primary outcomes were the initiation of CPR and use of AED prior to EMS (i.e. ambulance) arrival. For purposes of this analysis, EMS refers to ambulance personnel, and non-EMS includes both lay bystanders and first responders such as law enforcement officers or non-paramedic firefighters. CPR and AED use were described using percentages and simple logistic regression. Analyses were performed with Stata 14.1 (StataCorp LP, College Station TX, USA). The study protocol was approved by the Allina Health Institutional Review Board.

Results

A total of 1588 OHCA were treated by AH-EMS during the study timeframe, and 707 occurred in the 17 HS communities. After exclusion of unwitnessed arrests (n = 306), EMS-witnessed arrests (n = 61), arrests with non-cardiac etiology (n = 43) and pediatric events (n = 3), 294 events remained for analysis; 120 occurred before HS designation and 174 occurred after.

Overall, bystanders initiated CPR in 33% of the events, and placed AEDs in 5% (Table 2). Prior to HS designation, 83% of victims received CPR before ambulance arrival, but this figure rose to 95% after HS designation (OR = 4.23 [1.80–9.98]). Similarly, pre-ambulance AED use increased from 63% to 77% with HS designation (OR = 1.94 [1.16–3.24]). Both of these increases appeared to be largely attributable to improvements in first responder intervention rather than strong gains in bystander action. Overall unadjusted survival to hospital discharge was slightly higher after HS designation, but this difference was not statistically significant (17% vs 20%, p = 0.32).

Discussion

Prompt delivery of chest compressions significantly increases the likelihood of survival after OHCA³, yet the majority of victims of witnessed OHCA in the United States are still unlikely to receive bystander CPR. [2,9] Defibrillator use before EMS arrival also

increases the odds of survival by as much as 62% [10], but even when bystanders initiate chest compressions, concurrent AED use may only occur 10% of the time. [11] With adequate training and access to AEDs, bystanders and first responders can dramatically reduce time to these critical interventions by providing them while ALS units are en route, but there remains a need for implementation science to evaluate and hone programs that aim to translate pre-EMS resuscitation guidelines into practice. This report suggests completion of the HS program in Minnesota communities is associated with increased pre-ambulance CPR and AED use.

Strategic efforts in Denmark to engage citizens in resuscitation efforts have resulted in dramatic and sustained improvements in bystander CPR [12,13], including a national initiative that increased bystander CPR from 21% to 45% over a ten-year period. [14] In the US, a state-wide effort in Arizona [15] and community-level interventions in Texas [16] and Minnesota [17] have all achieved ten percentage point increases in bystander CPR rates within the last decade. Improvements in bystander action have recently been shown to be associated with higher survival to hospital discharge with favorable neurological function and fewer nursing home admissions [18]. Two initiatives in the state of Minnesota have successfully improved resuscitation outcomes using broader, system-based approaches that extend into the EMS and hospital care domains [9,17], and the current report highlights the apparent success of smaller-scale, individual community-initiated programming that specifically targets the role of community members and first responders. It appears that much of the gain from HS may be occurring in first responders rather than laypersons, which may reflect more rapid recognition of OHCA as a result of additional training as well as increased access to AEDs in first responder vehicles. The rate of bystander CPR in the state of Minnesota is estimated to be lower than the national average (33% vs 39%) [9], so improving engagement of bystanders may need to become a heightened area for focus in the HS program.

This preliminary retrospective analysis of the HS program covers only three years of OHCA from a single ambulance service area and this requires consideration in interpretation. The short timeframe limits sample size, and the homogeneity of the communities studied (i.e. all were non-urban locales with populations <90,000 and had self-selected to participate in HS) is a limitation because population demographics and community characteristics are important determinants of public engagement in resuscitation [19]. Other media campaigns and interventions not directly related to the HS program may have influenced early CPR and AED use. We did not conduct a robust analysis of outcomes as the objective was to determine whether HS improves adherence to guidelines for pre-ambulance response. We did not observe a survival benefit but the sample size was inadequate for such an effect to be seen. In the recent study by Kragholm et al. [18], survival benefit from bystander CPR was observed in 2100 patients over 10 years, and the difference in bystander CPR increased by 14 percentage points to 80%, an extremely high mark for our population.

An important next step is a state-wide analysis of HS with additional years of follow-up, a more complete analysis of outcomes, and an examination of community characteristics. Of critical importance is continued attention to the program's efficacy in terms of addressing rates of bystander CPR in Minnesota, including consideration of how innovative approaches and technologies such as registering mobile phone numbers of CPR trainees for event alerts [20], might be incorporated.

Conclusion

A community-based initiative increased the delivery of CPR and use of AEDs by bystanders and first responders prior to ambulance arrival.

Conflict of interest statement

There are no known conflicts of interest associated with this publication and there has been no financial support for this work that could have influenced its outcome.

All authors 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 authors

All authors 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.

All authors confirm that all aspects of the work covered in this manuscript have been conducted with approval by Allina Health's institutional review board with a waiver of informed consent.

All authors understand that the Corresponding Author is the sole contact for the Editorial process (including Editorial Manager and direct communications with the office). She is responsible for communicating with the other authors about progress, submissions of revisions and final approval of proofs. We confirm that lori.boland@allina.com is the current, correct email address to use for correspondence related to this manuscript.

Acknowledgements

None.

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