Oregon Health & Science University
School of Medicine

Scholarly Projects Final Report

Title *(Must match poster title; include key words in the title to improve electronic search capabilities.)*

> **Out-of-Hospital Cardiac Arrest Outcomes when Law Enforcement Arrives First and Initiates**

Student Investigator's Name

> Erika Johnson

Date of Submission *(mm/dd/yyyy)*

> 02/21/23

Graduation Year

> 2023

Project Course *(Indicate whether the project was conducted in the Scholarly Projects Curriculum; Physician Scientist Experience; Combined Degree Program [MD/MPH, MD/PhD]; or other course.)*

> Scholarly Project

Co-Investigators *(Names, departments; institution if not OHSU)*

> **OHSU Department of Emergency Medicine: Mohamud Daya, Jonathan Jui, Kathryn Thompson, Matthew Neth, Craig Newgard, Ritu Sahni, Joshua R. Lupton**

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Mentor's Department

> Department of Emergency Medicine

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Concentration Lead's Name

David Buckley

Project/Research Question

How are patient outcomes affected when law enforcement arrives first and intervenes in out-of-hospital cardiac arrest compared to no bystander intervention?

Type of Project *(Best description of your project; e.g., research study, quality improvement project, engineering project, etc.)*

Research Study

Key words *(4-10 words describing key aspects of your project)*

Out-of-hospital cardiac arrest, law enforcement, CARDIOPULMONARY RESUSCITATION, AED, PDX Epistry

Meeting Presentations
If your project was presented at a meeting besides the OHSU Capstone, please provide the meeting(s) name, location, date, and presentation format below (poster versus . podium presentation or other).

SAEM 2022, New Orleans, May 2022, oral presentation

Publications *(Abstract, article, other)*
If your project was published, please provide reference(s) below in JAMA style.

Johnson E, Daya M, Jui J, Thompson K, Neth M, Newgard C, Sahni R, Lupton J. Out-of-Hospital Cardiac Arrest Outcomes When Law Enforcement Arrives First and Initiates Intervention. *Academic Emergency Medicine – Annual Meeting Supplement*. 2022; 29: S184

Submission to Archive
Final reports will be archived in a central library to benefit other students and colleagues. Describe any restrictions below (e.g., hold until publication of article on a specific date).

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Next Steps
What are possible next steps that would build upon the results of this project? Could any data or tools resulting from the project have the potential to be used to answer new research questions by future medical students?

> Future steps include comparing outcomes to OUT-OF-HOSPITAL CARDIAC ARREST cases when bystanders intervene

Please follow the link below and complete the archival process for your Project in addition to submitting your final report.

https://ohsu.ca1.qualtrics.com/jfe/form/SV_3ls2z8V0goKiHZP

Student's Signature/Date *(Electronic signatures on this form are acceptable.)*
This report describes work that I conducted in the Scholarly Projects Curriculum or alternative academic program at the OHSU School of Medicine. By typing my signature below, I attest to its authenticity and originality and agree to submit it to the Archive.

X _____
Student's full name

Mentor's Approval *(Signature/date)*

X _____
Mentor Name

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Report*: Information in the report should be consistent with the poster, but could include additional material. Insert text in the following sections targeting 1500-3000 words overall; include key figures and tables. Use Calibri 11-point font, single spaced and 1-inch margin; follow JAMA style conventions as detailed in the full instructions.*

Introduction *(≥250 words)*

The incidence of out-of-hospital cardiac arrests in the United States is approximately 350,000 each year. Of the out-of-hospital cardiac arrests that occur annually, the CARES data from 2005-2010 demonstrated that 37% were witnessed by lay individuals (non-EMS, non-medical)[1]. Much work has been done to improve out-of-hospital cardiac arrest survival rates through protocol modification and education. One approach has been improving lay persons knowledge of cardiopulmonary resuscitation and pre-hospital resuscitation. Cardiopulmonary resuscitation courses are required by many employers and a push to include training in high school education has bolstered the percent of the population able to provide aid. But, it remains common for no cardiopulmonary resuscitation, automated external defibrillator or other intervention to have been initiated before emergency medical teams arrive[2]. It has been well established that outcomes of patients who experience out-of-hospital cardiac arrest are improved when they receive quality cardiopulmonary resuscitation with the least amount of delay after cardiac arrest[3]. As such, getting those who are able and willing to provide life-saving interventions to the scene of an arrest as soon as possible is paramount.

One way to reduce the time from arrest to the initiation of compressions has been the employment of law enforcement. The idea being, if law enforcement is able to get to the patient before a bystander or emergency medical personnel, the shortened interval from arrest to compressions would save lives and improve patient outcomes. While this makes sense in theory, there is no good data suggesting these programs work. Law enforcement officers are often dispatched to out-of-hospital cardiac arrests despite limited evidence demonstrating a survival benefit. Our objective was to evaluate out-of-hospital cardiac arrest patient outcomes when law enforcement initiated interventions prior to fire or ambulance emergency medical services arrival compared to no interventions prior to emergency medical services arrival.

Methods *(≥250 words)*

For this study, we used data from the Portland Cardiac Arrest Epidemiologic Registry which included out-of-hospital cardiac arrest cases from 2011 to 2021. This registry contains data from out-of-hospital cardiac arrest cases treated by 16 different emergency medical service agencies in the Portland metropolitan region and has been collected with the hope of improving local out-of-hospital cardiac arrest outcomes.

In this analysis, we included data from all known non-traumatic out-of-hospital cardiac arrest cases with known law enforcement intervention status. Law enforcement interventions included cardiopulmonary resuscitation and/or automated external defibrillator utilization. We excluded cases with non-law enforcement bystander interventions and emergency medical services witnessed arrests in both groups. In doing this, we were able to evaluate the outcomes for those patients who received intervention from law enforcement compared to those who had no intervention prior to emergency medical services arrival.

The primary outcome measured was neurologically intact survival. This was defined as a cerebral performance category score ≤2 or modified Rankin scale ≤3. We reported unadjusted outcomes and

adjusted odds ratios (aOR) from multivariable logistic regression. We adjusted for age, sex, bystander witness, public location, first EMS rhythm, dispatch to EMS arrival time, year, and county. We additionally analyzed a subgroup with only ideal law enforcement care. We defined "ideal law enforcement care as arrests where both cardiopulmonary resuscitation was performed in addition to the application of an automated external defibrillator.

This study was 80% powered (alpha 0.05) in the primary analysis to detect a 5% difference, the minimum clinically important difference recommended in out-of-hospital cardiac arrest studies.

Results *(≥500 words)*

Of 7,062 cases, 2,083 met criteria. 3,657 cases were excluded as there was non-law enforcement intervention prior to the arrival of emergency medical services (most commonly bystanders). 881 cases were excluded due to being witnessed by emergency medical services. 363 cases were excluded due to a lack of known cardiopulmonary resuscitation or automated external defibrillator application prior to emergency medical services arrival. 184 cases were excluded due to missing covariates. 1,977 had all covariates, including 312 with any law enforcement intervention, 106 ideal law enforcement care, and 1,665 with no pre-EMS intervention.

Rates of neurologically intact survival (95% CI) were higher when law enforcement intervened (8.7% [5.5-11.8]) and with ideal law enforcement care (11.3% [5.3-17.4]) compared to no pre-EMS intervention (7.6% [6.4-8.9]). While they were higher, the difference was not statistically significant (law enforcement intervention versus no intervention p=0.535, ideal law enforcement care versus no intervention p=0.171).

Rates of survival to discharge (95% Cl) were higher when law enforcement intervened (10.3% [6.9-13.6]) and with ideal law enforcement care (14.2% [7.4-20.9]) compared to no pre-EMS intervention (9.0% [7.6-10.3]). While they were higher, the difference was not statistically significant (law enforcement intervention versus no intervention p=0.463, ideal law enforcement care versus no intervention p=0.073).

Rates of return of spontaneous circulation (ROSC) (95% CI) were similar when law enforcement intervened (27.6% [22.6-32.6]) compared to no pre-EMS intervention [27.6% [25.5-29.8]). But, rates of ROSC were higher with ideal law enforcement care (31.13% [25.5-29.8]) than no intervention. This difference was not statistically significant (p=0.435).

In multivariable regression, compared to no pre-EMS intervention, neither any law enforcement intervention (aOR [95% CI]: 1.23 [0.73-2.09]) nor ideal law enforcement care (1.71 [0.82-3.54]) were significantly associated with neurologically intact survival (p=0.435 and p=0.151, respectively). When initial emergency medical services rhythm was not adjusted for, there was no statistically significant difference between any law enforcement intervention (1.44 [0.90-2.31]) versus no pre-EMS intervention (p=0.127), but there were higher odds of neurologically intact survival with ideal law enforcement (2.33 [1.24-4.39]) care compared to no pre-EMS intervention (p=0.009).

When initial emergency medical services rhythm was adjusted for, there was no statistically significant difference between any law enforcement intervention (aOR [95% CI]: 1.32 [0.81-2.16]) versus no pre-EMS intervention (p=0.264), but there were higher odds of survival to hospital discharge with ideal law enforcement (1.97 [1.00-3.88]) care compared to no pre-EMS intervention (p=0.049). When initial emergency medical services rhythm was not adjusted for, there was no statistically significant difference between any law enforcement intervention (1.49 [0.96-2.32]) versus no pre-EMS intervention (p=0.073),

but there were higher odds of survival to hospital discharge with ideal law enforcement (2.63 [1.46-4.75]) care compared to no pre-EMS intervention (p=0.001).

In multivariable regression, compared to no pre-EMS intervention, neither any law enforcement intervention (aOR [95% CI]: 1.03 [0.75-1.40]) nor ideal law enforcement care (1.21 [0.75-1.93]) were significantly associated with ROSC (p=0.163 and p=0.425, respectively). Additionally, compared to no pre-EMS intervention, neither any law enforcement intervention (aOR [95% CI]: 1.10 [0.82-1.48]) nor ideal law enforcement care (1.41 [0.90-2.19]) were significantly associated with ROSC (p=0.168 and p=0.151, respectively) when the data was not adjusted for initial emergency medical services rhythm.

Discussion *(≥500 words)*

Out-of-hospital cardiac arrests are responsible for a significant amount of morbidity and mortality in the United States each year. Efforts to improve the public knowledge of cardiopulmonary resuscitation and the use of automated external defibrillators has coincided with improved bystander intervention[2]. Unfortunately, this rate remains lower than it could be. Advances in EMS protocols and police dispatch have also been part of the approach to improve outcomes, though data is limited in regards to the effectiveness of the latter. This study looked at patient outcomes when police arrive first and provide intervention.

Patients from the PDX Epistry database with out-of-hospital cardiac arrest who receive law enforcement interventions before EMS arrival did not have significantly better neurologically intact survival compared to patients with no pre-EMS interventions. Ideal law enforcement care appears to be associated with improved survival to hospital discharge (p=0.049) in the primary analysis. In a sensitivity analysis, with no adjustment for initial EMS rhythm, ideal law enforcement care was associated with higher odds of neurologically intact survival.

It is difficult to determine if initial emergency medical services rhythm is a confounding variable that should be adjusted for. While the effectiveness of law enforcement may be altered by the cardiac rhythm, it is also possible that the rhythm is affected by the intervention. This chicken and egg scenario muddies the water as we look for clarity on the effectiveness of law enforcement. This is especially true given the statistically significant difference seen in the data not adjusted for initial emergency medical services rhythm that is not present when the data is adjusted.

To further put these results in context, it is important to remember that this study was evaluating an idealized version of law enforcement intervention. Any improvement in outcomes due to law enforcement dispatch would be diminished by the percentage of times that law enforcement actually arrives first. Additionally, it relies on them having good training and access to automated external defibrillators, something that is not ubiquitous. Before investing the large financial and workforce resources to dispatch law enforcement to all out-of-hospital cardiac arrests, it would be prudent to further investigate their effectiveness in improving patient outcomes. Future studies should assess further if law enforcement care improves outcomes in all-comers with out-of-hospital cardiac arrest through observational or trial research; how many law enforcement personnel need to be dispatched to save one life; and the costs associated with routine law enforcement dispatch.

There were several limitations to this study. First, our patients were from a single region (Portland metropolitan area) and may not be generalizable to the greater United States. Additionally, our study may

be underpowered (powered at 80% to detect a 5% change in neurologic outcome in the primary analysis). Because we do see improved survival, ROSC and neurologically intact survival that are not statistically significant, it seems very possible that a statistically significant difference would be found if there was a larger sample size.

Conclusions *(2-3 summary sentences)*

Patients with out-of-hospital cardiac arrest who received law enforcement interventions before EMS arrival did not have significantly better neurologically intact survival compared to patients with no pre-EMS interventions except in the case of ideal law enforcement care. Further studies are needed to elucidate the value of law enforcement intervention in out-of-hospital cardiac arrest.

References *(JAMA style format)*

1. McNally B, Robb R, Mehta M, et al. Out-of-hospital cardiac arrest surveillance --- Cardiac Arrest Registry to Enhance Survival (CARES), United States, October 1, 2005--December 31, 2010. *MMWR Surveill Summ*. 2011;60(8):1-19. Accessed October 31, 2020. http://www.ncbi.nlm.nih.gov/pubmed/21796098

2. Wissenberg M, Lippert FK, Folke F, et al. Association of national initiatives to improve cardiac arrest management with rates of bystander intervention and patient survival after out-of-hospital cardiac arrest. *JAMA*. 2013;310(13):1377-1384. doi:10.1001/JAMA.2013.278483

3. Yan S, Gan Y, Jiang N, et al. The global survival rate among adult out-of-hospital cardiac arrest patients who received cardiopulmonary resuscitation: a systematic review and meta-analysis. *Crit Care*. 2020;24(1). doi:10.1186/S13054-020-2773-2