

Out of Hospital Bystander CPR Rates in Baltimore City, Maryland, 2020-2022, Compared to State and National Rates: A Preliminary Report

Christian Angelo I Ventura^{1,2}, Benjamin J Lawner^{3,4}, Jennifer E Guyther³⁻⁵, Jason Gullion⁶

¹Department of Health, Behavior and Society, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD, USA; ²Department of Natural and Physical Sciences, Baltimore City Community College, Baltimore, MD, USA; ³Office of the Medical Director, Baltimore City Fire Department, Baltimore, MD, USA; ⁴Department of Emergency Medicine, University of Maryland School of Medicine, Baltimore, MD, USA; ⁵Department of Pediatrics, University of Maryland School of Medicine, Baltimore, MD, USA; ⁶Office of Quality Improvement, Baltimore City Fire Department, Baltimore, MD, USA

Correspondence: Christian Angelo I Ventura, Department of Health, Behavior and Society, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD, USA, Tel +1 (732) 372-2141, Email cventura@bcc.edu

Abstract: This preliminary study was a rapid retrospective analysis of out-of-hospital cardiac arrest (OHCA) cases from Baltimore City between January 2020 and December 2022, using data from the Cardiac Arrest Registry to Enhance Survival. Of the 1,282 cases in 2022, 27.4% received bystander CPR compared to 40.7% in Maryland and 40.8% nationwide. These findings suggest individuals experiencing OHCA in Baltimore City are 45% less likely to receive bystander CPR. Despite community education initiatives and dispatch-assisted protocols, the low bystander CPR rate indicates significant barriers to intervention. Addressing these disparities may necessitate a health equity-focused investigation into public awareness, CPR training access, and sociocultural factors.

Keywords: out-of-hospital cardiac arrest, cardiopulmonary resuscitation, emergency medical services

Introduction

Out-of-hospital cardiac arrest (OHCA) is a critical public health concern, representing a significant cause of mortality and morbidity globally, with over 475,000 cases annually in the United States alone.¹ Despite advancements in emergency medical services (EMS) and public health interventions, survival rates for OHCA remain starkly low, with less than 10% of patients achieving survival to hospital discharge.¹ The etiological landscape of OHCA is multifaceted, encompassing various underlying pathologies, often presenting without prior symptoms. As such, immediate intervention, particularly bystander cardiopulmonary resuscitation (BCPR), has been identified as a key determinant of both survival and favorable neurological outcomes.^{2,3} Other factors that influence survival rates include early activation of the emergency response system and the incidence of a witnessed cardiac arrest.⁴ The American Heart Association underscores the importance of early CPR, noting its role in maintaining circulatory flow and delaying ischemic injury during the critical minutes before EMS arrival.² This rapid report presents a preliminary cross-institutional retrospective analysis of OHCA data from Baltimore City, spanning January 2020 to December 2022, comparing local bystander CPR rates to state and national benchmarks.

Methods

A retrospective cross-sectional study was conducted using aggregate data from the Cardiac Arrest Registry to Enhance Survival (CARES) database,⁵ focusing on OHCA cases in Baltimore City between January 2020 and December 2022. CARES, a nationwide surveillance system, collects detailed information on OHCA cases in which resuscitation efforts were initiated by EMS. The dataset includes variables related to patient demographics, event location, type of arrest,

bystander intervention, and outcomes. To contextualize local outcomes, the study compared Baltimore City data to both Maryland state and national statistics.

Inclusion criteria for this analysis encompassed all non-traumatic OHCA cases in which resuscitation (defined as CPR and/or defibrillation) was performed by a bystander outside of the 911 response system. Cases involving traumatic arrest, do-not-resuscitate orders, or instances where resuscitation was not attempted were excluded. Data were extracted from CARES Summary Reports and Utstein Survival Reports,⁶ which provide a standardized format for reporting cardiac arrest survival metrics. Descriptive statistics were employed to summarize key variables, including patient sex, age, race, arrest location, and bystander CPR rates. Bystander CPR was defined as any resuscitative effort provided by a layperson or non-medical professional prior to EMS arrival. Bystander CPR rates for Baltimore City were calculated for each year from 2020 to 2022 and compared to corresponding rates at the state and national levels. Odds ratios were computed to assess the likelihood of receiving bystander CPR in Baltimore City relative to state and national averages, and 95% confidence intervals were used to determine the precision of these estimates. The study did not include 2023 data as the bystander CPR rates for that year were not yet available. Statistical analyses were performed using Stata BE, with significance set at $p < 0.05$.⁷ This study assessed for temporal trends and potential disparities in bystander CPR rates across the study period, with a focus on determining the influence of demographic and situational factors on resuscitative efforts. Results were presented in aggregate form, and specific comparisons were made between Baltimore City's performance and broader state and national trends to contextualize the findings and inform public health interventions.

Our study was determined to be exempt from Institutional Review Board (IRB) oversight by federal regulations because it involved the retrospective analysis of de-identified, aggregate data from the Cardiac Arrest Registry to Enhance Survival (CARES) database. No identifiable private information was collected or analyzed, and the data utilized were publicly available in summary reports. Additionally, the study did not involve any intervention or interaction with individuals, nor did it include any primary data collection, thus posing no risk to participants. The nature of the analysis qualifies it under exempt category 4 of the Common Rule HHS CFR 46.104, which pertains to secondary research for which consent is not required.

Preliminary Results

From 2020 to 2022, a total of $N=4,113$ OHCA cases were reported in Baltimore City. The BCPR rate decreased over this period, from 29.6% in 2020 to 27.4% in 2022. In contrast, the BCPR rates for Maryland remained consistently higher, ranging from 40.7% to 42.4%, while national rates were relatively stable at around 40.7–40.8%. Comparative analyses revealed that individuals experiencing OHCA in Baltimore City were significantly less likely to receive bystander CPR than those in Maryland or nationwide. In 2022, $n=1,282$ OHCA cases fit the criteria. Approximately 59.0% were male patients, 74.9% of cases were Black/African-American, with 70.9% of arrests occurring at home/in-residence. The mean age was 58.9 years. In 2022, the OR for receiving BCPR in Baltimore City versus Maryland was 0.5497 (95% CI: 0.4799, 0.6235), and 0.5478 (95% CI: 0.4842, 0.6190) compared to national rates, reflecting a 45% lower likelihood of bystander intervention in Baltimore City. Similar disparities were observed for 2020 and 2021, with consistently lower odds of BCPR in Baltimore relative to both state and national averages. Summative findings from 2020–2021 are displayed in Table 1.

Table 1 Aggregate Out-of-Hospital Cardiac Arrest (OHCA) and Bystander CPR (BCPR) Rates in Baltimore City Compared to Maryland and National BCPR Rates from 2020 to 2022

Year	Baltimore City OHCA Cases (BCPR Rate %)	Maryland OHCA Cases (BCPR Rate %)	National OHCA Cases (BCPR Rate %)	BCPR Odds Ratio: Baltimore vs Maryland	BCPR Odds Ratio: Baltimore vs National
2020	$n=1,444$ (29.6)	$n=7,850$ (42.4)	$n=127,366$ (40.8)	0.5874 (95% CI: 0.5105, 0.6772)	0.6498 (95% CI: 0.5643, 0.7487)
2021	$n=1,387$ (28.2)	$n=7,667$ (42.2)	$n=146,922$ (40.7)	0.5630 (95% CI: 0.4872, 0.6514)	0.6016 (95% CI: 0.5212, 0.6935)
2022	$n=1,282$ (27.4)	$n=7,459$ (40.7)	$n=147,736$ (40.8)	0.5497 (95% CI: 0.4799, 0.6235)	0.5478 (95% CI: 0.4842, 0.6190)

Discussion

The findings of this preliminary analysis reveal that, as of 2022, individuals experiencing non-traumatic OHCA in Baltimore City were approximately 45% less likely to receive BCPR compared to both state and national averages. This stark disparity persists despite the implementation of dispatch-assisted CPR protocols and targeted community education programs. These results underscore the pressing need to explore and address the underlying barriers that contribute to the alarmingly low BCPR rates in Baltimore City.

Several potential factors may explain these disparities. Public awareness of the importance of CPR and the availability of training programs may be limited in specific communities. Fratta et al have shown that lack of familiarity with CPR techniques, fear of causing harm, and uncertainty about legal protections can deter bystander intervention. Additionally, cultural or social dynamics, including mistrust of healthcare institutions, may exacerbate reluctance to intervene.⁸ The sociodemographic profile of Baltimore City, where most OHCA patients are Black or African American, may highlight the role of structural inequities and resource access in bystander CPR disparities. Socioeconomic factors, including race/ethnicity, income inequality and education, have been linked to lower bystander CPR rates in underserved populations.⁹

This preliminary report underscores the urgent need for a comprehensive, region-specific assessment of barriers to bystander CPR to better understand the community and individual factors affecting intervention. Reducing overall substance use and improving chronic disease management in high-risk populations may also help reduce incidence of OHCA. Targeted, health equity-driven interventions, combined with ongoing CPR training and response monitoring, are crucial for improving OHCA outcomes in this urban population. Future studies should focus on identifying and addressing specific barriers to bystander CPR in Baltimore City, prioritizing equity, education, and community engagement.

Conclusion

This preliminary analysis reveals significant disparities in bystander CPR rates for out-of-hospital cardiac arrest in Baltimore City compared to state and national averages. Despite existing protocols and community education efforts, individuals in Baltimore City were 45% less likely to receive bystander CPR, indicating persistent barriers to intervention. These findings highlight the need for a comprehensive, region-specific assessment to better understand the factors influencing CPR rates, including public awareness, training access, and sociodemographic inequities. Addressing these disparities through targeted, equity-focused interventions, improved community engagement, and ongoing monitoring is critical to improving OHCA outcomes in this high-risk urban population. Future research should focus on identifying specific barriers and developing tailored solutions to enhance bystander CPR rates in Baltimore City.

Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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References

1. Virani SS, Alonso A, Benjamin EJ, et al. Heart disease and stroke statistics-2020 update: a report from the American Heart Association. *Circulation*. 2020;141(9):e139–e596. doi:10.1161/CIR.0000000000000757
2. Cummins RO, Ornato JP, Thies WH, Pepe PE. Improving survival from sudden cardiac arrest: the “chain of survival” concept. A statement for health professionals from the advanced cardiac life support subcommittee and the emergency cardiac care committee, American Heart Association. *Circulation*. 1991;83(5):1832–1847. doi:10.1161/01.cir.83.5.1832
3. Bobrow BJ, Spaite DW, Berg RA, et al. Chest compression-only CPR by lay rescuers and survival from out-of-hospital cardiac arrest. *JAMA*. 2010;304(13):1447–1454. doi:10.1001/jama.2010.1392
4. Deakin CD. The chain of survival: not all links are equal. *Resuscitation*. 2018;126:80–82. doi:10.1016/j.resuscitation.2018.02.012
5. McNally B, Stokes A, Crouch A, Kellermann AL; CARES Surveillance Group. CARES: cardiac arrest registry to enhance survival. *Ann Emerg Med*. 2009;54(5):674–683.e2. doi:10.1016/j.annemergmed.2009.03.018
6. Perkins GD, Jacobs IG, Nadkarni VM, et al. Cardiac arrest and cardiopulmonary resuscitation outcome reports: update of the Utstein resuscitation registry templates for out-of-hospital cardiac arrest: a statement for healthcare professionals from a task force of the International Liaison Committee on Resuscitation (American Heart Association, European Resuscitation Council, Australian and New Zealand Council on Resuscitation, Heart and Stroke Foundation of Canada, InterAmerican Heart Foundation, Resuscitation Council of Southern Africa, Resuscitation Council of Asia); and the American Heart Association Emergency Cardiovascular Care Committee and the Council on Cardiopulmonary, Critical Care, Perioperative and Resuscitation [published correction appears in *Circulation*. 2015 Sep 29;132(13):e168–e169. doi: 10.1161/CIR.0000000000000301]. *Circulation*. 2015;132(13):1286–1300. doi:10.1161/CIR.0000000000000144
7. StataCorp. *Stata Statistical Software: Release BE*. College Station, TX: StataCorp LLC.
8. Fratta KA, Bouland AJ, Vesselinov R, et al. Evaluating barriers to community CPR education. *Am J Emergency Med*. 2020;38(3):603–609. doi:10.1016/j.ajem.2019.10.019
9. Garcia RA, Spertus JA, Girotra S, et al. Racial and ethnic differences in bystander CPR for witnessed cardiac arrest. *New Engl J Med*. 2022;387(17):1569–1578. doi:10.1056/NEJMoa2200798

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