Published in final edited form as:
Circulation. 2020 January 07; 141(1): 34–41. doi:10.1161/CIRCULATIONAHA.119.041541.

Variation in bystander cardiopulmonary resuscitation delivery and subsequent survival from out-of-hospital cardiac arrest based on neighborhood-level ethnic characteristics

Audrey L. Blewer, Ph.D., M.P.H.[1,*], **Robert H. Schmicker, M.S.**[2], **Laurie J. Morrison, M.D., MS**[3], **Tom P. Aufderheide, M.D.**[4], **Mohamud Daya, M.D., M.S.**[5], **Monique A. Starks, M.D., M.H.S.**[6], **Susanne May, Ph.D.**[2], **Ahamed H. Idris, M.D.**[7], **Clifton W. Callaway, M.D., Ph.D.**[8], **Peter J. Kudenchuk, M.D.**[9], **Gary M. Vilke, M.D.**[10], **Benjamin S. Abella, M.D., M.Phil**[11], **Resuscitation Outcomes Consortium (ROC) Investigators**

[1]Department of Family Medicine and Community Health, Duke University, Durham, NC

[2]The Clinical Trial Center, University of Washington, Seattle, WA

[3]Rescu, Li Ka Shing Knowledge Institute, St. Michael's Hospital, Emegency Medicine, Department of Medicine, University of Toronto, Toronto, Ontario Canada

[4]Department of Emergency Medicine, Medical College of Wisconsin, Milwaukee, WI

[5]Department of Emergency Medicine, Oregon Health and Science University, Portland, OR

[6]Duke Clinical Research Institute, Duke University, Durham, NC

[7]Department of Emergency Medicine, University of Texas Southwestern Medical Center, Dallas, TX

[8]Department of Emergency Medicine, University of Pittsburgh, Pittsburgh, PA

[9]Department of Medicine, University of Washington, Seattle, WA

[10]Department of Emergency Medicine, University of California San Diego, La Jolla, CA

[11]Department of Emergency Medicine and Center for Resuscitation Science, University of Pennsylvania, Philadelphia, PA

Abstract

[*]Corresponding author and requests for reprints (Audrey L. Blewer): Audrey.Blewer@duke.edu, mobile: (267) 239-1765, fax: (919) 684-8675, US mail: Duke University School of Medicine, Department of Family Medicine and Community Health, 2200 W Main Street, Suite 600, Room 611, Durham, NC, 27705.

Disclosures:
Dr. Blewer received funding from the American Heart Association (Mentored Clinical Research Program Award). Dr. Laurie Morrison is the Robert and Dorothy Pitts Chair in Acute Care and Emergency Medicine at Li Ka Shing Knowledge Institute at St. Michael's Hospital. She volunteers for the American Heart Association and the International Liaison Committee on Resuscitation. She has current funding from the Canadian Institute of Health Research and the Heart and Stroke Foundation of Canada. She has received research funding and salary support from the National Institute of Health as a ROC PI in Toronto Ontario Canada. Dr. Tom P. Auferheide, Dr. Mohamud Daya, Dr. Clifton Callaway, and Peter Kudenchuk receives research funding from the National Institutes of Health. Dr. Ahamed Idris receives research funding from the National Institutes of Health and Physio-Control (Heart Sine), as well as in-kind support. He serves as a volunteer for the American Heart Association. Dr. Abella receives research funding from the NIH, PCORI, the Medtronic Foundation, the American Heart Association and CR Bard. He receives honoraria from Philips Healthcare and CR Bard, as well as in-kind research support from Laerdal Medical Corporation.

Background: Bystander cardiopulmonary resuscitation (B-CPR) delivery and survival from out-of-hospital cardiac arrest (OHCA) varies at the neighborhood level, with lower survival seen in predominantly Black neighborhoods. Despite Hispanics being the fastest growing minority population in the US, few studies have assessed whether the proportion of Hispanics in a neighborhood is associated with B-CPR delivery and survival from OHCA. We assessed whether B-CPR rates and survival vary by neighborhood-level ethnicity. We hypothesized that neighborhoods with a higher proportion of Hispanics have lower B-CPR rates and lower survival.

Methods: We conducted a retrospective cohort study, using data from the Resuscitation Outcomes Consortium (ROC) Epistry at US sites. Neighborhoods were classified by census tract, based on percentage of Hispanic residents: < 25%, 25%-50%, 51%-75%, or > 75%. We independently modeled the likelihood of receipt of B-CPR and survival by neighborhood-level ethnicity controlling for site and patient-level confounding characteristics.

Results: From 2011-2015, ROC collected 27,481 US arrest events; after excluding pediatric arrests, EMS-witnessed arrests, or arrests occurring in a healthcare or institutional facility, 18,927 were included. B-CPR was administered in 37% of events. Among neighborhoods with <25% Hispanic residents, B-CPR was administered in 39% of events, while it was administered in 27% of events among neighborhoods with >75% Hispanic residents. Compared with <25% Hispanic neighborhoods in a multivariable analysis, OHCA in predominantly Hispanic neighborhoods had lower B-CPR rates (51%-75% Hispanic: OR: 0.79 (CI:0.65-0.95), p=0.014, >75% Hispanic: OR: 0.72 (CI: 0.55-0.96), p=0.025) and lower rates of survival (global p-value: 0.029, >75% Hispanic: OR: 0.56 (CI: 0.34-0.93), p=0.023).

Conclusions: Individuals with OHCA in predominantly Hispanic neighborhoods were less likely to receive B-CPR and had lower likelihood of survival. These findings suggest an important need to understand the underlying disparities in CPR delivery and an unmet CPR training need among Hispanic communities.

Keywords

Cardiopulmonary resuscitation; sudden cardiac arrest; Hispanic ethnicity

Introduction

Receipt of bystander CPR (B-CPR) improves a victim's chance of survival from out-of-hospital cardiac arrest (OHCA).[1, 2] Studies have demonstrated that B-CPR rates are low in many US communities.[3-5] The National Academy of Medicine and the American Heart Association have highlighted increasing B-CPR as a crucial national objective.[6, 7]

Recent investigations have demonstrated disparities in B-CPR rates by neighborhood-level characteristics, such as racial composition and socioeconomic status.[8-12] A study conducted in North Carolina demonstrated that low B-CPR rates were associated with neighborhoods characterized by a higher percentages of Black residents and persons living in poverty (Black: OR, 3.73, 95% CI: 2.00–6.97, Poverty: OR, 1.77, 95% CI: 1.16–2.71).[10] Despite Hispanics being the fastest growing minority population in the US, few studies have assessed whether the proportion of Hispanics in a neighborhood is associated with B-CPR delivery and survival from OHCA.[13-15] Understanding the impact of neighborhood-level

Hispanic ethnicity on B-CPR delivery has the potential to inform future targeted initiatives to increase B-CPR delivery and improve outcomes from OHCA.

Using data from the OHCA registry Resuscitation Outcomes Consortium (ROC), a North American resuscitation research network, we conducted a retrospective cohort study to assess whether there is variation in B-CPR rates by neighborhood-level ethnicity. We hypothesized that neighborhoods with a higher proportion of Hispanics are associated with lower B-CPR rates and lower survival.

Methods

Study Design

We conducted a secondary retrospective analysis of a prospective study, examining differences in B-CPR rates and outcomes based on neighborhood-level ethnicity among adult, non-traumatic cardiac arrest events that occurred in the out-of-hospital setting. To assess these questions, we used clinical trial data collected prospectively by the U.S. sites of the ROC from April, 2011-June, 2015, including Alabam*a*, Dallas, Milwaukee, San Diego, Pittsburgh, Portland, and Seattle-King County. The University of Pennsylvania Institutional Review Board reviewed the protocol and determined this study to be exempt from requirements for informed consent and additional review. The data and supporting statistical documentation is available on request from the authors.

Data Sources

ROC represented an NIH-funded clinical trial network focused on OHCA and traumatic injury, ending in 2015. Data were collected from Emergency Medical Services (EMS) agencies and maintained by a data coordinating center at the University of Washington. Since 2006, ROC collected data from 11 municipal regions in the US and Canada. Collected variables at the patient level included B-CPR (chest compression only or chest compressions with ventilations) and other time-sensitive OHCA data elements. ROC epidemiologic data have been reported in various clinical trial publications.[16-18]

To account for neighborhood characteristics, we used census tract estimates from the 2014 American Community Survey conducted by the U.S. Census Bureau.[19] The American Community Survey provides small area estimates (census tract) of areas formally surveyed via the decennial census long-form. Variables collected include census tract-level gender proportion, ethnicity proportion, median age, and median education and income. Hispanic ethnicity was self-reported and the variable does not differentiate whether the respondents identify as first generation or second generation.

Patient-level variables

Consistent with our prior work, we defined B-CPR by its delivery from a bystander prior to EMS arrival excluding CPR from law enforcement or EMS first responders.[20] We excluded pediatric victims (age<18) and those who experienced OHCA from traumatic injury. We also excluded arrest events that occurred in a residential instutition (e.g. skilled nursing facility) or healthcare center and arrest events that were witnessed by EMS. Patient race and

ethnicity were modeled categorically; age was modelled as a continuous variable. Location of cardiac arrest was defined as non-public (i.e. home) or public (i.e. street/highway, public building, place of recreation, or other public location). Event time of day was grouped based on assumed daily activity consistent with other published studies (6:00am-8:59am, 9:00am-3:59pm, 4:00pm-6:59pm, 7:00pm-10:59pm, and 11:00pm-5:59am).[20, 21]

There were 19,331 OHCA arrest events that fit our inclusion criteria. When excluding the 404 events that occurred in census tracts that had only one or less OHCA to maintain data de-identification, the final analysis was conducted on 18,927 subjects.

Neighborhood-level variables

Census tract characteristics were included from the American Community Survey and added into the ROC dataset merging by census tracts. Since our primary exposure of interest was neighborhood-level Hispanic residents, neighborhoods were classified by census tract, based on percentage of Hispanic residents: < 25%, 25%−50%, 51%−75%, or > 75%. This classification was consistent with prior work.[9]

As a sensitivity analysis, we examined modeling percentage of individuals that lived in a census tract that identified as Hispanic as a continuous variable, and categorically by quartile (0–4.8%, 4.9%−11%, 11.1%−27.1%, 27.2%−97.3%). By doing so, we analyzed the data by distribution of number of Hispanics that lived in the community. Given prior studies, we reported the primary findings using ethnicity categories of <25%, 25%−50%. 51%−75%, and >75%.[9]

Statistical Analysis

We analyzed data using STATA 15.1 (Statacorp, College Station, TX). The dataset was not missing any data on the primary outcome or independent variable of interest. There was variation in rates of missing data among the secondary dependent variables from 0–4.8% with the exception of patient-level race and ethnicity which were missing 37.04% and 29.16%, respectively. This degree of missing data is consistent with prior ROC studies where ascertainment of race was difficult in the prehospital setting during time-sensitive resuscitation of an unconscious victim.[20] As a sensitivity analysis to examine the degree of bias introduced by the missing data, we used multivariate normal multiple imputation (“mi impute mvn” command in STATA) to impute the missing covariates of interest (50 imputations), and rounded the imputed categorical variables of interest as appropriate (e.g. the number 2 was given to any value greater than 1.49 and less than or equal to 2.49).

Using logistic regression modeling, we analyzed whether there were differences in B-CPR rates and survival by neighborhood-level ethnicity. We built models for the likelihood of overall B-CPR delivery and survival. Patient-level variables with $p<0.15$ for association in a univariate analysis entered into a multivariable model. The final regression model included B-CPR, site, time of event, location of event, time of bystander calling to arrival of EMS, witness status, and patient demographics (age, race, ethnicity, gender). We included and modeled site as a fixed effect in the final regression equation. We used post-estimation methods to examine final regression model fit. As a secondary analysis, we examined the univariate, multivariable, and multiple imputation models for B-CPR rate and survival

independently and stratified by public and private locations. Additionally, as a secondary analysis, we included median household income as a covariate in our final regression model.

Results

Characteristics of OHCA events

Of the cohort, 6,948/18,927 (37%) received B-CPR, the mean age was 63.73±17.27, and 11,957/18,914 (63%) of whom were male. Overall, 7,729/11,917 (65%) of the patients were White, 3,448/11,917 (29%) were Black, and 856/13,407 (6%) were Hispanic ethnicity, while 13,890/18,927 (73%) of the cardiac arrests occurred in neighborhoods with <25% Hispanic ethnicity, and 2,697/18,927 (14%) occurred in neighborhoods with 25%−50% Hispanic ethnicity (Table 1). To examine differences in census tracts with varying percentages of Hispanic residents, we included a Supplemental Table 1.

Unadjusted analysis of B-CPR delivery and neighborhood ethnicity

In an unadjusted analysis, compared to neighborhoods of <25% Hispanic ethnicity, persons with OHCA in neighborhoods with 51%−75% Hispanic ethnicity had a 39% lower odds of receive B-CPR (OR: 0.61 (95% CI: 0.55–0.68) p<0.001), and those in neighborhoods with greater than 75% Hispanic ethnicity had a 40% lower odds of receiving B-CPR (OR: 0.60 (95% CI: 0.50–0.71) p<0.001) (Table 2).

The sensitivity analyses modeling neighborhood ethnicity continuously and by quartiles yielded similar findings where increased percentage of neighborhood Hispanic ethnicity were associated with a decreased likelihood of receiving B-CPR.

Multivariable logistic regression of B-CPR and neighborhood ethnicity

In a multivariable logistic regression model using complete case analysis including patient-level race and ethnicity, arrest time, location of arrest, and other potentially confounding variables, neighborhood Hispanic ethnicity was associated with decreased likelihood of receipt of B-CPR (global p-value = 0.026). Compared to those in <25% Hispanic neighborhoods, persons were less likely to receive B-CPR during OHCA in neighborhoods with 51%−75% Hispanic ethnicity (OR: 0.79 (95% CI: 0.65–0.95), p=0.014) and >75% Hispanic ethnicity (OR: 0.72 (95% CI: 0.55–0.96), p=0.025) (Table 2).

To account for missing patient-level data, we used multiple imputation as a sensitivity analysis to assess the association of neighborhood-level Hispanic ethnicity on likelihood of B-CPR. Similar to the complete case analysis, persons with OHCA in neighborhoods with 51%−75% Hispanic ethnicity and >75% Hispanic ethnicity, were less likely to receive B-CPR compared to those in <25% Hispanic neighborhoods (Supplemental Table 2). Furthermore, we explored the effect of median household income in this analysis and found similar results. (Supplemental Table 3).

Patient-level survival and neighborhood ethnicity

Overall, in a multivariable analysis, neighborhood-level Hispanic ethnicity was associated with a lower likelihood of patient’s survival to hospital discharge (global p-value=0.029).

Cardiac arrests that occurred in neighborhoods with >75% identified Hispanic ethnicity had a 44% lower likelihood of survival as compared to those that lived in neighborhoods with <25% reported Hispanic ethnicity (OR: 0.56 (95% CI: 0.34–0.93), p=0.023) (Table 3). These findings were similar when accounting for missing data using multiple imputation and including median household income (Supplemental Table 3 and Supplemental Table 4).

B-CPR rate, survival, and neighborhood ethnicity in public and private locations

In an unadjusted analysis of neighborhood ethnicity and B-CPR stratified by public and private locations, neighborhood-level Hispanic ethnicity was associated with a lower likelihood of B-CPR (global p-value <0.001, both). When controlling for confounding variables, the relationship between neighborhood ethnicity and B-CPR stratified by public and private locations were no longer significant (Table 4). We observed a similar relationship with neighborhood ethnicity and survival, stratified by private and public locations, possibly due to the small sample size (Table 5).

Discussion

Within the ROC OHCA database, a higher level of reported Hispanic ethnicity was associated with a lower likelihood of B-CPR, when compared to communities with a lower proportion of Hispanic ethnicity. A similar association was observed between survival to hospital discharge from OHCA and Hispanic ethnicity within these communities. Our findings have implications for developing targeted training programs and local initiatives to improve the frequency of B-CPR in Hispanic communities, which are the fastest growing minority group in the United States.

B-CPR and Hispanic Neighborhoods

Large disparities exist in both the provision of CPR and survival from OHCA across communities.[8, 9, 13, 20] A recent study found that people living in low-income Black neighborhoods were much less likely to receive B-CPR compared to high-income White neighborhoods (OR: 0.49, 95% CI 0.41–0.58).[8] Furthermore, a recent publication examining B-CPR and racial composition of neighborhoods, specifically Black residents, found that those with OHCA in predominantly Black neighborhoods had lower rates of B-CPR and significantly lower likelihood for survival compared with predominantly White neighborhoods (>75% Black: OR, 0.63, 95% CI: 0.50–0.79; p<0.01).[9] Other studies have examined the relationship of B-CPR with socioeconomic status, characterized by education or income on a neighborhood census-level. For example, an investigation in North Carolina examined B-CPR and population composition finding that lower rates of B-CPR were associated with percent of individuals living in poverty (OR: 1.77, 95% CI: 1.16–2.71, per 1% increase in patients living in poverty).[10] While studies have examined neighborhood racial composition and socioeconomic status, to our knowledge, no study had specifically examined ethnicity, B-CPR and subsequent survival. Recent work has demonstrated higher rates of B-CPR in other non-US communities.[2] Given the low B-CPR rate in the US, our work suggests an important need to increase CPR training in predominantly Hispanic communities, and a key opportunity to improve survival rates.

Targeted CPR training for Hispanic communities

Recent studies have investigated barriers to B-CPR for residents in primarily Hispanic communities. For example, a qualitative investigation of residents in Denver, Colorado evaluated barriers to calling 911 and performing CPR for residents in primarily Hispanic, high-risk neighborhoods.[22] One of the findings suggested the need to increase availability to tailored education in Spanish. Additionally, recent work from our team examined self-identified ethnicity and automatic external defibrillator (AED) training prevalence in the US and found that self-identified Whites and Blacks were more likely to have AED training compared to Hispanics (OR: 1.90, 95% CI: 1.43–2.53 and OR: 1.73, 95% CI: 1.39–2.15, respectively).[23] Combined with the findings from this current project, it is important to consider targeted training for Hispanic neighborhoods, communities, and populations to increase CPR and AED training and knowledge. A recent study demonstrated the feasibility and efficacy of targeted training for Hispanics at soccer matches.[24] Future studies and public health initiatives should consider methods to provide the trainings with cultural competency and Spanish language considerations.

Considerations for Dispatch-assisted CPR and Hispanic communities

Another key element that may improve B-CPR provision and subsequent survival from OHCA in communities, is the provision of dispatch-CPR, in which CPR instructions are given by a trained dispatcher by telephone. Studies have demonstrated that the provision of D-CPR in communities is linked with increased survival from OHCA.[25-27] Few studies have examined the barrier bystanders who call 9–1-1 may encounter with D-CPR if the bystander speaks Spanish and the dispatcher cannot provide instructions in Spanish.[22, 28, 29] In prior work investigating Hispanic community key informants, subjects mentioned increasing the number of Spanish speaking 9–1-1 dispatchers for consideration of residents in Hispanic communities.[22] In addition to investigating professional response to Hispanic victims of OHCA, future studies should examine both D-CPR and professional emergency response to OHCA in predominantly Hispanic neighborhoods to improve efforts in these communities.

Limitations

There are a number of limitations with our study, including that the study design was a secondary analysis of a larger prospective study. However, data were collected rigorously because of ongoing clinical trials such that the potential bias usually seen in a voluntary prospective registry was likely minimal. Some sites had few communities with >25% Hispanics which limited our ability to fully investigate the associations between survival and B-CPR and ethnic composition of the neighborhoods. Race and ethnicity variables had significant missing data, but to account for this we used multiple imputation to address the missingness. Findings were similar in the complete case analysis and multiple imputation datasets. We did not observe a difference when stratifying the data by public and private locations in a multivariable analysis but that may be due to the small sample size. Of additional interest is variation by gender, race, socioeconomic status, and ethnicity. Unfortunately, this analysis is limited by the small sample size in this dataset. Additionally, it is important to consider variation of B-CPR and survival by Hispanic ethnic sub-populations. While we did not have the necessary information in this dataset, it would an

interesting topic for future investigation. Lastly, we were unable to quantify the ethnicity or other demographic characteristics of bystanders, nor the frequency of D-CPR, thus, we were unable to provide insight as to the cause for these underline inequities. While challenging, future work should concentrate on assessing bystander characteristics in these particular neighborhoods.

Conclusions

Individuals in predominantly Hispanic neighborhoods were less likely to receive B-CPR and had a lower likelihood of survival to hospital discharge. These findings should inform future messaging around B-CPR and educational initiatives including the provision of D-CPR targeting largely Hispanic neighborhoods. More broadly, these findings suggest an important need to understand the reasons for these underlying disparities in CPR delivery, particularly in Hispanic neighborhoods.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgements:

We acknowledge Shaun K. McGovern, EMT-B for his assistance with data management, acquisition, and data analysis.

Sources of Funding: This work was supported by a Mentored Clinical and Population Award from the American Heart Association (15MCPRP25090161).

The ROC was supported by a series of cooperative agreements to nine regional clinical centers and one Data Coordinating Center (5U01 HL077863-University of Washington Data Coordinating Center, HL077866-Medical College of Wisconsin, HL077867-University of Washington, HL077871-University of Pittsburgh, HL077872-St. Michael's Hospital, HL077873-Oregon Health and Science University, HL077881-University of Alabama at Birmingham, HL077885-Ottawa Hospital Research Institute, HL077887-University of Texas SW Medical Ctr/Dallas, HL077908-University of California San Diego) from the National Heart, Lung and Blood Institute in partnership with the U.S. Army Medical Research & Material Command, The Canadian Institutes of Health Research (CIHR) - Institute of Circulatory and Respiratory Health, Defence Research and Development Canada, the Heart, Stroke Foundation of Canada and the American Heart Association. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Heart, Lung and Blood Institute or the National Institutes of Health.

Non-standard Abbreviations and Acronyms

CPR	Cardiopulmonary resuscitation
B-CPR	Bystander cardiopulmonary resuscitation
OHCA	Out-of-hospital cardiac arrest
ROC	Resuscitation Outcomes Consortium
EMS	Emergency Medical Services
AED	Automatic External Defibrillator
D-CPR	Dispatch-CPR

REFERENCES

1. Kragholm K, Wissenberg M, Mortensen RN, Hansen SM, Malta Hansen C, Thorsteinsson K, Rajan S, Lippert F, Folke F, Gislason G, et al. Bystander Efforts and 1-Year Outcomes in Out-of-Hospital Cardiac Arrest. N Engl J Med. 2017;376:1737–1747. [PubMed: 28467879]
2. Hasselqvist-Ax I, Riva G, Herlitz J, Rosenqvist M, Hollenberg J, Nordberg P, Ringh M, Jonsson M, Axelsson C, Lindqvist J, et al. Early cardiopulmonary resuscitation in out-of-hospital cardiac arrest. N Engl J Med. 2015;372:2307–2315. [PubMed: 26061835]
3. Girotra S, van Diepen S, Nallamothu BK, Carrel M, Vellano K, Anderson ML, McNally B, Abella BS, Sasson C, Chan PS, et al. Regional Variation in Out-of-Hospital Cardiac Arrest Survival in the United States. Circulation. 2016;133:2159–2168. [PubMed: 27081119]
4. Chan PS, McNally B, Tang F, Kellermann A and CARES Surveillance Group. Recent trends in survival from out-of-hospital cardiac arrest in the United States. Circulation. 2014;130:1876–1882. [PubMed: 25399396]
5. Nichol G, Thomas E, Callaway CW, Hedges J, Powell JL, Aufderheide TP, Rea T, Lowe R, Brown T, Dreyer J, et al. Regional variation in out-of-hospital cardiac arrest incidence and outcome. JAMA. 2008;300:1423–1431. [PubMed: 18812533]
6. Graham R, McCoy MA and Schultz AM, eds. Strategies to Improve Cardiac Arrest Survival: A Time to Act. Washington (DC): National Academies Press (US); 2015 9.
7. Sasson C, Meischke H, Abella BS, Berg RA, Bobrow BJ, Chan PS, Root ED, Heisler M, Levy JH, Link M, et al. Increasing cardiopulmonary resuscitation provision in communities with low bystander cardiopulmonary resuscitation rates: a science advisory from the American Heart Association for healthcare providers, policymakers, public health departments, and community leaders. Circulation. 2013;127:1342–1350. [PubMed: 23439512]
8. Sasson C, Magid DJ, Chan P, Root ED, McNally BF, Kellermann AL, Haukoos JS and CARES Surveillance Group. Association of neighborhood characteristics with bystander-initiated CPR. N Engl J Med. 2012;367:1607–1615. [PubMed: 23094722]
9. Starks MA, Schmicker RH, Peterson ED, May S, Buick JE, Kudenchuk PJ, Drennan IR, Herren H, Jasti J, Sayre M, et al. Association of Neighborhood Demographics With Out-of-Hospital Cardiac Arrest Treatment and Outcomes: Where You Live May Matter. JAMA Cardiol 2017;2:1110–1118. [PubMed: 28854308]
10. Fosbol EL, Dupre ME, Strauss B, Swanson DR, Myers B, McNally BF, Anderson ML, Bagai A, Monk L, Garvey JL, et al. Association of neighborhood characteristics with incidence of out-of-hospital cardiac arrest and rates of bystander-initiated CPR: implications for community-based education intervention. Resuscitation. 2014;85:1512–1517. [PubMed: 25180920]
11. Root ED, Gonzales L, Persse DE, Hinchey PR, McNally B and Sasson C. A tale of two cities: the role of neighborhood socioeconomic status in spatial clustering of bystander CPR in Austin and Houston. Resuscitation. 2013;84:752–759. [PubMed: 23318916]
12. Brown TP, Booth S, Hawkes CA, Soar J, Mark J, Mapstone J, Fothergill RT, Black S, Pocock H, Bichmann A, et al. Characteristics of neighbourhoods with high incidence of out-of-hospital cardiac arrest and low bystander cardiopulmonary resuscitation rates in England. Eur Heart J Qual Care Clin Outcomes. 2019;5:51–62. [PubMed: 29961881]
13. Moon S, Bobrow BJ, Vadeboncoeur TF, Kortuem W, Kisakye M, Sasson C, Stolz U and Spaite DW. Disparities in bystander CPR provision and survival from out-of-hospital cardiac arrest according to neighborhood ethnicity. Am J Emerg Med. 2014;32:1041–1045. [PubMed: 25066908]
14. Bosson N, Fang A, Kaji AH, Gausche-Hill M, French WJ, Shavelle D, Thomas JL and Niemann JT. Racial and ethnic differences in outcomes after out-of-hospital cardiac arrest: Hispanics and Blacks may fare worse than non-Hispanic Whites. Resuscitation. 2019;137:29–34. [PubMed: 30753852]
15. Vadeboncoeur TF, Richman PB, Darkoh M, Chikani V, Clark L and Bobrow BJ. Bystander cardiopulmonary resuscitation for out-of-hospital cardiac arrest in the Hispanic vs the non-Hispanic populations. Am J Emerg Med. 2008;26:655–660. [PubMed: 18606316]

16. Weisfeldt ML, Everson-Stewart S, Sitlani C, Rea T, Aufderheide TP, Atkins DL, Bigham B, Brooks SC, Foerster C, Gray R, et al. Ventricular tachyarrhythmias after cardiac arrest in public versus at home. N Engl J Med. 2011;364:313–321. [PubMed: 21268723]

17. Nichol G, Leroux B, Wang H, Callaway CW, Sopko G, Weisfeldt M, Stiell I, Morrison LJ, Aufderheide TP, Cheskes S, et al. Trial of Continuous or Interrupted Chest Compressions during CPR. N Engl J Med. 2015;373:2203–2214. [PubMed: 26550795]

18. Kudenchuk PJ, Brown SP, Daya M, Rea T, Nichol G, Morrison LJ, Leroux B, Vaillancourt C, Wittwer L, Callaway CW, et al. Amiodarone, Lidocaine, or Placebo in Out-of-Hospital Cardiac Arrest. N Engl J Med. 2016;374:1711–1722. [PubMed: 27043165]

19. US Census Bureau, American Community Survey. 2014 https://www.census.gov/programs-surveys/acs. Accessed October 2017.

20. Blewer AL, McGovern SK, Schmicker RH, May S, Morrison LJ, Aufderheide TP, Daya M, Idris AH, Callaway CW, Kudenchuk PJ, et al. Gender Disparities Among Adult Recipients of Bystander Cardiopulmonary Resuscitation in the Public. Circ Cardiovasc Qual Outcomes. 2018;11:e004710. [PubMed: 30354377]

21. Wallace SK, Abella BS, Shofer FS, Leary M, Agarwal AK, Mechem CC, Gaieski DF, Becker LB, Neumar RW and Band RA. Effect of time of day on prehospital care and outcomes after out-of-hospital cardiac arrest. Circulation. 2013;127:1591–1596. [PubMed: 23509060]

22. Sasson C, Haukoos JS, Ben-Youssef L, Ramirez L, Bull S, Eigel B, Magid DJ and Padilla R. Barriers to calling 911 and learning and performing cardiopulmonary resuscitation for residents of primarily Latino, high-risk neighborhoods in Denver, Colorado. Ann Emerg Med. 2015;65:545–552. [PubMed: 25481112]

23. Owen DD, McGovern SK, Murray A, Leary M, Del Rios M, Merchant RM, Abella BS, Dutwin D and Blewer AL. Association of race and socioeconomic status with automatic external defibrillator training prevalence in the United States. Resuscitation. 2018;127:100–104. [PubMed: 29631005]

24. Del Rios M, Morales G, Han J, Campbell T, Sharp L and Gerber B. Major League Soccer Provides a Captive Audience for Promoting Bystander CPR and AED Use Among Hispanics. J Natl Med Assoc. 2018;110:326–329. [PubMed: 30126556]

25. Wu Z, Panczyk M, Spaite DW, Hu C, Fukushima H, Langlais B, Sutter J and Bobrow BJ. Telephone cardiopulmonary resuscitation is independently associated with improved survival and improved functional outcome after out-of-hospital cardiac arrest. Resuscitation. 2018;122:135–140. [PubMed: 28754526]

26. Bobrow BJ, Spaite DW, Vadeboncoeur TF, Hu C, Mullins T, Tormala W, Dameff C, Gallagher J, Smith G and Panczyk M. Implementation of a Regional Telephone Cardiopulmonary Resuscitation Program and Outcomes After Out-of-Hospital Cardiac Arrest. JAMA Cardiol. 2016;1:294–302. [PubMed: 27438108]

27. Takahashi H, Sagisaka R, Natsume Y, Tanaka S, Takyu H and Tanaka H. Does dispatcher-assisted CPR generate the same outcomes as spontaneously delivered bystander CPR in Japan? Am J Emerg Med. 2018;36:384–391. [PubMed: 28844727]

28. Nuno T, Bobrow BJ, Rogge-Miller KA, Panczyk M, Mullins T, Tormala W, Estrada A, Keim SM and Spaite DW. Disparities in telephone CPR access and timing during out-of-hospital cardiac arrest. Resuscitation. 2017;115:11–16. [PubMed: 28342956]

29. Garcia del Aguila J, Lopez-Messa J, Rosell-Ortiz F, de Elias Hernandez R, Martinez del Valle M, Sanchez-Santos L, Lopez-Herce J, Cerda-Vila M, Roza-Alonso CL, Bernardez-Otero M, et al. Recommendations in dispatcher-assisted bystander resuscitation from emergency call center. Med Intensiva. 2015;39:298–302. [PubMed: 25895627]

Health Research Alliance Author Manuscript

CLINICAL PERSPECTIVE

What is new?

- While Hispanics are the fastest growing minority population in the US, few studies have assessed whether the proportion of Hispanics in a neighborhood is associated with bystander CPR delivery and survival from out-of-hospital cardiac arrest.
- We assessed whether bystander CPR rates and survival vary by neighborhood-level ethnicity and found that individuals with out-of-hospital cardiac arrest in predominantly Hispanic neighborhoods were less likely to receive bystander CPR and had lower likelihood of survival.

What are the clinical implications?

- This study highlights a potential unmet CPR training need and the importance of researching provision of dispatch-assisted CPR within largely Hispanic neighborhoods.
- Furthermore, these findings suggest an important need to understand the underlying disparities in CPR delivery within predominently Hispanic communities.

Health Research Alliance Author Manuscript

Table 1.

Study cohort: cardiac arrest event and demographic characteristics.

	All	B-CPR Yes	B-CPR No
N	18,927	6,948 (37%)	11,979 (73%)
Hispanic Neighborhood Census Tracts, (%)			
<25%	13,890 (73%)	5,384 (77%)	8,506 (71%)
25%-50%	2,697 (14%)	915 (13%)	1,782 (15%)
51%-75%	1,625 (9%)	453 (7%)	1,172 (10%)
>75%	715 (4%)	196 (3%)	519 (4%)
Site			
A	984 (5%)	241 (3%)	743 (6%)
B	5,257 (28%)	1,448 (21%)	3,809 (32%)
C	2,548 (13%)	401 (6%)	2,147 (18%)
D	1,551 (8%)	545 (8%)	1,006 (8%)
E	2,212 (12%)	1,204 (17%)	1,008 (8%)
F	2,465 (13%)	1,032 (15%)	1,433 (12%)
G	3,910 (21%)	2,077 (30%)	1,833 (16%)
Time of day			
11:00pm-5:59am	3,574 (19%)	1,283 (19%)	2,291 (19%)
6:00am-8:59am	2,597 (14%)	901 (13%)	1,696 (14%)
9:00am-3:59pm	6,454 (34%)	2,369 (34%)	4,085 (34%)
4:00pm-6:59pm	2,847 (15%)	1,112 (16%)	1,735 (15%)
7:00pm-10:59pm	3,315 (18%)	1,225 (18%)	2,090 (18%)
Location type			
Street, highway	848 (4%)	263 (4%)	585 (5%)
Public building	319 (2%)	143 (2%)	176 (2%)
Place of recreation	380 (2%)	218 (3%)	162 (1%)
Home	15,505 (82%)	5,469 (79%)	10,036 (84%)
Other public	1,640 (9%)	767 (11%)	873 (7%)
Other non-public	147 (1%)	71 (1%)	76 (1%)
Age, years	63.73±17.27	62.49±17.13	64.45±17.31
Male	11,957 (63%)	4,509 (65%)	7,448 (62%)

Health Research Alliance Author Manuscript

	All	B-CPR Yes	B-CPR No
Race			
White	7,729 (65%)	3,152 (74%)	4,577 (60%)
Black	3,448 (29%)	741 (18%)	2,707 (35%)
Asian	521 (4%)	243 (6%)	278 (4%)
Pacific Islander	72 (1%)	40 (1%)	32 (0%)
Native American	36 (0%)	18 (0%)	18 (0%)
Other Race	34 (0%)	14 (0%)	20 (0%)
Multi-Races	77 (1%)	26 (1%)	51 (1%)
Ethnicity			
Hispanic	856 (6%)	248 (5%)	608 (7%)
Non-Hispanic	12,551 (94%)	4,412 (95%)	8,139 (93%)
Calling 911, to arrival of EMS	5.26±2.30	5.51±2.46	5.11±5.07
Witnessed	7,802 (43%)	3,483 (52%)	4,319 (38%)
Survival to hospital discharge			
Yes	2,228 (12%)	1,154 (17%)	1,074 (9%)

Missing variables: Time of Day: 140 (0.74%), Location type: 88 (0.46%), Age: 5 (0.03%), Sex: 13 (0.07%), Arrival of EMS: 778 (4.11%), Witness: 909 (4.80%), Race: 7,010 (37%), Ethnicity 5,520 (29%), Survival: 57 (0.30%), Site: A=Alabama, B=Dallas, C=Milwaukee, D=Pittsburgh, E=Portland, F=San Diego, G=Seattle. B-CPR: Bystander CPR., EMS:emergency medical services; B-CPR: bystander cardiopulmonary resuscitation

Health Research Alliance Author Manuscript

Table 2.

Likelihood of B-CPR delivery by neighborhood-level ethnicity

	Univariate Analysis			*Multivariable Analysis*		
	B-CPR OR (95% CI) n=18,927	**Global**	**p-value**	**B-CPR OR (95% CI) n=9,406**	**Global**	**p-value**
Hispanic neighborhood						
Census tract, OR (95% CI)						
<25%	-	<0.001		-	0.026	
25%-50%	0.81 (0.74-0.88)		<0.001	0.91 (0.78-1.05)		0.191
51%-75%	0.61 (0.55-0.68)		<0.001	0.79 (0.65-0.95)		0.014
>75%	0.60 (0.50-0.71)		<0.001	0.72 (0.55-0.96)		0.025

OR: Odds Ratio, CI: Confidence Interval, B-CPR: Bystander cardiopulmonary resuscitation, Global: Global P-value from the Wald test. Multivariable regression controlling for site, time of day, location type, age, race of patient, ethnicity of patient, gender, bystander call to arrival of emergency medical services, and witness status

Health Research Alliance Author Manuscript

Table 3.

Likelihood of survival by neighborhood ethnicity

	Univariate Analysis			*Multivariable Analysis*		
	Survival OR (95% CI) n=18,870	**Global**	**p-value**	**Survival OR (95% CI) n=10,213**	**Global**	**p-value**
Hispanic neighborhood Census tract, OR (95% CI)						
<25%	-	<0.001		-	0.029	
25%-50%	0.83 (0.73-0.95)		0.006	1.18 (0.97-1.44)		0.099
51%-75%	0.62 (0.52-0.75)		<0.001	1.08 (0.82-1.42)		0.565
<75%	0.44 (0.32-0.60)		<0.001	0.56 (0.34-0.93)		0.023

OR: Odds Ratio, CI: Confidence Interval, Global: Global P-value from the Wald test. Multivariable analysis controlling for site, episode time, location type, age, gender, and race of patient

Health Research Alliance Author Manuscript

Table 4.

Likelihood of B-CPR stratified by public and private location

	Public			***Private***		
	B-CPR OR (95% CI)	**Global**	**p-value**	**B-CPR OR (95% CI)**	**Global**	**p-value**
Univariate Analysis	n=3,187			n=15,505		
Hispanic neighborhood						
Census tract, OR (95% CI)						
<25%	-	<0.001		-	<0.001	
25%-50%	0.73 (0.59-0.90)		0.003	0.83 (0.75-0.91)		<0.001
51%-75%	0.52 (0.38-0.70)		<0.001	0.65 (0.57-0.73)		<0.001
<75%	0.61 (0.42-0.91)		0.020	0.60 (0.49-0.72)		<0.001
Multivariable Analysis	n=1,486			n=7,853		
Hispanic neighborhood						
Census tract, OR (95% CI)						
<25%	-	0.302		-	0.124	
25%-50%	0.98 (0.68-1.40)		0.907	0.89 (0.76-1.05)		0.165
51%-75%	0.67 (0.41-1.11)		0.118	0.81 (0.66-1.00)		0.052
>75%	0.64 (0.33-1.27)		0.203	0.77 (0.56-1.05)		0.096

OR: Odds Ratio, CI: Confidence Interval, B-CPR: Bystander cardiopulmonary resuscitation, Global: Global P-value from the Wald test. Multivariable regression controlling for site, time of day, location type, age, race of patient, ethnicity of patient, gender, bystander call to arrival of emergency medical services, and witness status

Health Research Alliance Author Manuscript

Table 5.

Likelihood of survival stratified by public and private location

	Public			***Private***		
	Survival OR (95% CI)	**Global**	**p-value**	**Survival OR (95% CI)**	**Global**	**p-value**
Univariate Analysis	n=3,169			n=15,468		
Hispanic neighborhood						
Census tract, OR (95% CI)						
<25%	-	<0.001		-	<0.001	
25%-50%	0.77 (0.61-0.98)		0.034	0.88 (0.75-1.04)		0.126
51%-75%	0.73 (0.52-1.02)		0.068	0.65 (0.52-0.82)		<0.001
<75%	0.28 (0.15-0.52)		<0.001	0.53 (0.36-0.77)		0.001
Multivariable Analysis	n=1,476			n=7,843		
Hispanic neighborhood						
Census tract, OR (95% CI)						
<25%	-	0.055		-	0.128	
25%-50%	1.11 (0.76-1.61)		0.595	1.29 (1.01-1.64)		0.038
51%-75%	1.02 (0.62-1.67)		0.941	1.22 (0.87-1.70)		0.242
>75%	0.24 (0.08-0.69)		0.008	0.87 (0.50-1.53)		0.636

OR: Odds Ratio, CI: Confidence Interval, Global: Global P-value from the Wald test. Multivariable analysis controlling for site, episode time, location type, age, gender, and race of patient