

Racial, ethnic, and socioeconomic disparities in out-of-hospital cardiac arrest within the United States: Now is the time for change



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This review highlights the current evidence on racial, ethnic, and socioeconomic disparities in cardiac arrest outcomes within the United States. Several studies demonstrate that patients from Black, Hispanic, or lower socioeconomic status backgrounds suffer the most from disparities at multiple levels of the resuscitation pathway, including in the provision of bystander cardiopulmonary resuscitation, defibrillator usage, and postresuscitation therapies. These gaps in care may altogether lead to lower survival rates and worse neurological outcomes for these patients. A multisystem, culturally sensitive approach to improving cardiac arrest outcomes is suggested in this article.

KEYWORDS Out-of-hospital cardiac arrest; Racial disparities; Ethnic disparities; Socioeconomic disparities; Cardiopulmonary resuscitation; Defibrillation; Postresuscitation care; Health care delivery

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Introduction

Out-of-hospital cardiac arrest (OHCA) affects approximately 250,000 Americans annually, per recent estimates.¹ Nationwide, survival rates from OHCA are poor despite advancement in technologies, with an average survival rate of 10.6%.¹ However, there appears to be considerable variation in incidence and survival from OHCA across racial and socioeconomic lines. Several studies show that racial and ethnic minorities as well as people from lower socioeconomic status (SES) backgrounds are more likely to suffer from OHCA but are less likely to survive to hospital discharge compared to their White or higher-income counterparts.^{2–14} There is significant regional variation in OHCA survival that may also be driven by racial and socioeconomic differences throughout the United States.^{15,16} For instance, per the Resuscitation Outcomes Consortium observational data, survival from OHCA in rural Alabama is 500% lower than it is in suburban King County, Washington.¹⁶

These disparities in OHCA outcomes may be explained by the impact of race and SES on the performance of critical “chain of survival” actions, which leads to differences in patient prognosis and survival. The 4 “chain of survival” actions designated by the American Heart Association include (1) quick recognition of cardiac arrest and activation of emergency medical services (EMS); (2) provision of bystander cardiopulmonary resuscitation (CPR); (3) delivery of shock(s) from a defibrillator, if indicated; and (4) advanced life support and postresuscitation care (Figure 1).¹⁷ National registry data corroborate that bystander CPR is performed less commonly in lower-income, non-White, and less highly educated communities.^{3,7,8,11,14} Survey data demonstrate that in some minority communities, inadequate training in CPR, cultural barriers to performing CPR, fear of legal or financial ramifications, and lack of access to defibrillator systems may underlie lower bystander CPR rates.^{18–20} Differences in EMS response or postresuscitation care following return of spontaneous circulation could also play a role in lowering OHCA survival within minority- and low-income-predominant neighborhoods.^{13,14,21–27} Altogether, these represent target areas where we can improve in our national response to OHCA to better care for patients across the racial, ethnic, and socioeconomic spectrum.

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KEY FINDINGS

- Minority and lower-income patients are more likely to suffer from poor cardiac arrest outcomes compared to White or higher-income patients
- Patients of lower socioeconomic status and minority backgrounds are less likely to receive high-quality cardiopulmonary resuscitation, such as timely bystander support and defibrillator usage if indicated
- Advanced life support delivered by emergency medical services and hospital-based postresuscitation care may be deficient in several key metrics for minority and lower-income patients

Recognition of cardiac arrest and bystander CPR

The first step to ensuring the survival of a patient with OHCA in the community is to have bystanders in the vicinity who recognize the emergency, call 911, and attempt CPR before EMS arrival. Layperson resuscitation attempts are vitally important because every minute of delay to CPR can reduce the chances of survival in OHCA by 10%.²⁸ On average, CPR is administered by bystanders in the United States 40% of the time when the arrest is unwitnessed by EMS or other healthcare personnel.¹ The chances of bystanders initiating CPR are higher if the arrest is witnessed in a public location.^{3,4} However, CPR provision by bystanders is highly unequal across US regions, cities, and neighborhoods. There is substantial evidence in the literature that the likelihood of receiving bystander CPR during OHCA is closely correlated with the income, education level, and racial/ethnic composition of the neighborhood where someone arrests. Some studies have demonstrated a positive relationship between income alone and the likelihood of receiving bystander CPR. Mitchell and colleagues²⁹ showed that in Washington state, higher bystander SES defined by multiple economic

variables (tax-assessed value, education, employment, median household income) was predictive of increased rates of bystander CPR with or without dispatcher instructions. In Fulton County (Atlanta), Georgia, Sasson and colleagues⁴ showed that people who arrested in the highest-income census tracts were more likely to receive bystander CPR than those who arrested in the lowest-income tracts. A recent meta-analysis of 10 international observational studies on OHCA outcomes (including the United States) also showed that the odds of receiving bystander CPR or surviving to hospital discharge were significantly lower for patients from lower SES backgrounds (odds ratio [OR] ~0.6).² Adjustment with combined SES indicators only marginally improved the odds (OR ~0.8).²

One of the largest studies in this field to date also demonstrates an additive effect of race to SES in determining the chances of receiving CPR.³ Sasson and colleagues³ showed that among 14,225 adult patients with cardiac arrest, patients from low-income, mostly Black neighborhoods were about 50% less likely to receive bystander CPR compared to patients from high-income, mostly White neighborhoods. However, a higher income only improved the chance of receiving CPR for a patient from a Black neighborhood by 25%, whereas it completely eliminated the disparity in CPR provision for patients from integrated neighborhoods.³ Patients who received bystander-initiated CPR were more likely to be found with a shockable rhythm, to receive treatment with a defibrillator, and to survive to hospital admission and discharge.³ Another study of 22,487 patients from the 2011 National Emergency Medical Services Information System, which examined medical emergencies as a whole, reported similar results for Black patients and also noted a curvilinear relationship between bystander support and county socioeconomic status.³⁰ In a study by Naim and colleagues⁷ exploring the interplay of race and socioeconomic parameters in pediatric patients, Black children were 50% less likely to receive bystander CPR if they lived in a

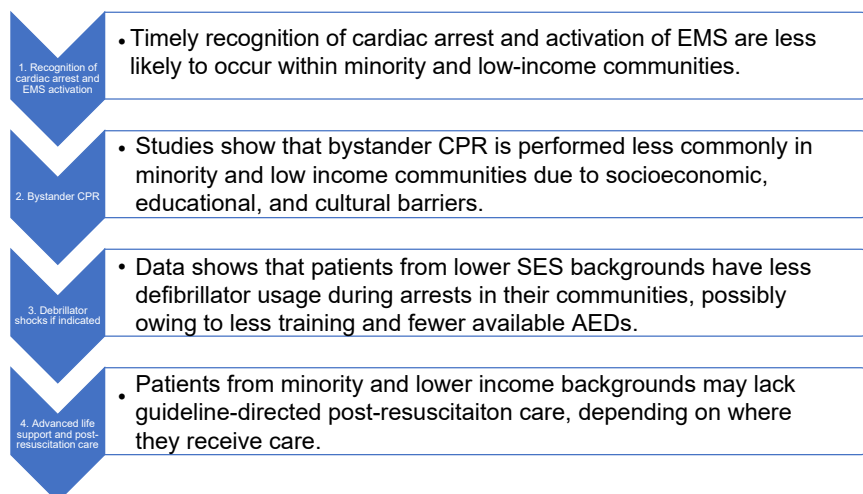


Figure 1 The 4 “Chain of Survival” actions for out-of-hospital cardiac arrest and how minority and/or lower income patients are negatively impacted for each action. AED = automated external defibrillator; CPR = cardiopulmonary resuscitation; EMS = emergency medical services.

neighborhood with the worst socioeconomic index compared to White children living in a neighborhood with the best index (based on % Black race, employment rates, educational attainment until high school, and median income). However, White children received CPR at similar rates regardless of the neighborhood they lived in.⁷

In addition to race, being ethnically Hispanic may also impact one's chances of receiving CPR. Multiple studies reported that significantly fewer Hispanic patients receive bystander CPR than non-Hispanic patients.^{6,8,10} In the state of Arizona, when distinguishing arrests by Hispanic vs non-Hispanic neighborhoods, Moon and colleagues⁶ observed that bystander CPR was administered less frequently in Hispanic neighborhoods specifically and that an initial shockable rhythm during arrest was also less common within Hispanic neighborhoods. Survival to hospital discharge was also significantly lower in Hispanic neighborhoods.⁶ On a national scale, using data from the Resuscitation Outcomes Consortium Epistry, Blewer and colleagues⁶ showed that among 18,927 adult arrests, neighborhoods that were >51% Hispanic had rates of bystander CPR delivery that were approximately 30% lower and rates of survival that were approximately 50% lower compared to neighborhoods that were <25% Hispanic.

Overall, both regional and national data corroborate the narrative that race, ethnicity, and socioeconomic parameters such as income and employment will in aggregate worsen disparities in OHCA bystander treatment. Black and Hispanic patients in the most socioeconomically disadvantaged neighborhoods are the least likely to receive bystander support.

Utilization of automated external defibrillators

The next step in the chain of survival, providing a defibrillator shock if indicated, is performed even more uncommonly than bystander CPR. Only 7% of arrests in 2019 involved use of an automated external defibrillator (AED).¹ However, almost 20% of arrests presented with an initial shockable rhythm, and survival increased 3-fold if the first rhythm was shockable.¹ A prospective, multicenter clinical trial with volunteer EMS units randomized to employ CPR plus an AED vs CPR alone demonstrated significantly higher rates of survival to hospital discharge for patients treated with an AED.³¹ However, similar to bystander CPR, disparities in AED knowledge and usage are widespread. A survey on AED training sent to a nationally representative sample of 9022 individuals showed that 68% of participants had never been trained in AED usage.³² Self-identified Whites and Blacks were more likely to be trained compared to Latinos.³² Having a graduate education significantly increased the odds of being trained compared to never having completed high school (OR 4.36).³² A large retrospective cohort study based on the Resuscitation Outcomes Consortium that examined the effect of Black race on survival and defibrillation outcomes in OHCA found that 5 times more patients were treated with an AED prior to EMS arrival in communities

that were <25% Black compared to communities that were >75% Black.¹⁴ The authors of the study speculate this was owing to fewer available AEDs in Black communities and the occurrence of fewer arrests in a public location where an AED could be available.¹⁴ These data suggest that AED usage is a critical component in the chain of survival and needs to improve both nationwide and specifically within minority communities before EMS arrival to achieve better outcomes after out-of-hospital arrest.

EMS response and postresuscitation care

The final component of the chain of survival is advanced life support and postresuscitation care, provided by EMS personnel and within hospitals. There is some data to suggest that a closer look at nationwide disparities in EMS response and hospital-based care may be worthwhile for OHCA. One of the most significant observational studies to date on OHCA examined Cardiac Arrest Registry to Enhance Survival (CARES) data from 250,000 adults between 2013 and 2017. It demonstrated that people living in census tracts with a majority Black or low-to-middle-income population were less likely to survive after hospital discharge from OHCA or survive without severe neurological disability.¹¹ However, surprisingly, their survival to hospital admission was similar to their White, higher-income counterparts.¹¹ This would argue against lower CPR performance in the field being the primary driver of poor survival in minority and low-income communities. Chan and colleagues¹¹ postulate that survival disparities by race, ethnicity, and income may actually be related to other, sparsely measured qualities of resuscitation care, such as EMS practices and hospital postresuscitation efforts.¹¹

CARES registry data from the early 2000s show that EMS agencies across the nation had highly heterogeneous structures and protocols.²¹ Not only did they differ in terms of medical direction, deployment strategies, and the quantity and level of experience of their EMS providers, but they also differed in terms of how strictly they adhered to advanced cardiac life support guidelines or whether they incorporated updates on medication and airway management.²¹ The use of advanced resuscitation techniques, including alternate airways, intraosseous lines, external compression devices, real-time CPR feedback, and field hypothermia also differed significantly among agencies, with older, more-established techniques such as alternate airways being more widely adopted.²¹ Although contemporary data on EMS organizational structures are not available, prior data suggest that best resuscitation practices were not being adopted by all EMS agencies, which may have contributed to substandard outcomes for certain groups of individuals.

Studies looking specifically into variations in EMS response based on neighborhood SES and race have reported inconsistent EMS arrival times for patients from minority and low-income backgrounds, one noting similar or shorter EMS arrival times for Black neighborhoods vs White, and another noting longer arrival times in the poorest neighborhoods,

even exceeding national benchmarks.^{14,22} Stark and colleagues¹⁴ found that while overall EMS treatment times were longer in predominantly Black communities, time to first defibrillation was also longer. A longer time to defibrillation is possible if cardiac arrests are occurring in urban areas with high-rise buildings, where it may take longer to reach the patient.¹⁴ A retrospective cohort study of more than 850,000 Medicare enrollees also showed that after an acute event such as cardiac arrest, a higher proportion of White patients were transported to the reference emergency department, the most common choice based on proximity and hospital capabilities, compared to Black or Hispanic patients.²³ The American College of Emergency Medicine recommends that transport to the closest appropriate facility should be the highest priority for EMS providers.²³ However, in major US cities, Black and Hispanic patients were more likely to be transported to safety-net emergency departments compared to their White counterparts.²³ Though such practices may be influenced by other factors, such as where a patient has received care in the past, they could also delay appropriate postresuscitation care, lowering overall odds of survival after OHCA.

Additionally, there is considerable evidence to suggest that systemic disparities exist in the quality of care provided by hospitals attended by minority patients compared to those attended by White patients. A large observational study from 2002 to 2005 showed that multiple systems of care for conditions such as congestive heart failure and community-acquired pneumonia, mainly involving medication management and counseling, were affected by where minority vs nonminority patients were treated.³³ More than half of elderly Hispanic patients were found to receive care at for-profit hospitals with low nurse staffing and poor performance metrics for common medical conditions.³⁴ In another study, national Medicare data for 3 high-risk surgical procedures were evaluated and showed that Black patients were 25%–58% more likely to undergo the procedures at hospitals deemed lower-quality for surgery compared to White patients, despite living closer to higher-quality hospitals.³⁵ Surgical quality was rated on procedure-specific mortality, which in composite is predicted by metrics such as hospital volume, procedural volume, and risk-adjusted mortality and morbidity of procedures.³⁵

Regarding postresuscitative care specifically, a retrospective study of hospitalizations after OHCA in California showed that both Black and Hispanic patients received significantly fewer guideline-directed postresuscitation therapies (cardiac catheterization after ventricular fibrillation/tachycardia, therapeutic hypothermia), but received more life-sustaining treatments such as percutaneous endoscopic gastrostomy tubes, tracheostomies, and dialysis.²⁴ Palliative care was also engaged less frequently for these patients.²⁴ Other studies also substantiate that non-White race is associated with a lower likelihood of receiving coronary angiography or treatment at a 24/7 percutaneous coronary intervention center.^{13,25} Additionally, some Hispanic/Latino-serving hospitals have been shown to provide less

guideline-directed targeted temperature management following OHCA.²⁶ However, a secondary analysis of adult OHCA patients enrolled in the Pragmatic Airway Resuscitation Trial did not find racial differences in advanced airway placement following OHCA.²⁷ Overall, although there is a paucity of data on the management of OHCA following EMS arrival, the available evidence suggests possible differences in EMS resuscitation efforts, the hospitals to which minority patients are transported, and the treatments minority patients ultimately receive at these hospitals. These hospitals tend to rank lower per quality metrics for the treatment of many acute medical conditions, including cardiac arrest.

Looking to the future

Despite the alarming nature of these findings on OHCA outcomes, a large population of the United States remains untrained or inadequately trained in basic life support. In a random survey of 9022 citizens in 2015, the prevalence of up-to-date CPR training was 18%, while the prevalence of past training was 65%.³⁶ Between 2010 and 2011, the median annual incidence of CPR training for all US counties was only 2.39%, although the major associations providing CPR training (American Heart Association, American Red Cross, Health and Safety Institute) mandate frequent recertification.³⁷

This training gap only widens when race, ethnicity, and SES are added to the equation. Blewer and colleagues reported that lower household income, lesser educational attainment, and older age were associated with a lower likelihood of CPR training.³⁶ An earlier study of CPR training rates across US counties by Anderson and colleagues³⁷ substantiates these findings, and also shows that counties with poor training rates are more likely to be located in the South or in rural areas, have a lower median household income, and/or have a higher proportion of Black and Hispanic residents. Qualitative studies shed light on the barriers preventing Black and Hispanic residents from learning and executing CPR.^{18,19} Among 3 high-risk neighborhoods of Columbus, OH, that were composed primarily of Black residents of lower SES, financial burden of CPR training, poor knowledge of CPR and difficulty seeking information in-person or online, potential legal action for being unsuccessful, lack of community cohesion, and personal health risks were the most commonly cited barriers to performing CPR during an arrest.¹⁹ Among 5 low-income Latino neighborhoods of Denver, CO, distrust of law enforcement and the repercussions of accidental disclosure of immigration status, financial burden, lack of recognition of cardiac arrest, and limited English proficiency were the primary reasons why residents avoided calling 911.¹⁸ Hesitation to performing CPR also involved cultural barriers pertaining to age; sex; and fear of strangers, racism, and inappropriate contact.¹⁸ Additional concerns elicited by a general US population at CPR training events included fear of harming geriatric, female, and adolescent patients and fear of inappropriately touching female patients or being accused of sexual assault.³⁸

Ostensibly, urgent action must be taken to improve OHCA outcomes for all patients, but particularly for those from racially diverse and lower income backgrounds, who suffer at all stages of the resuscitation pathway, from inadequate bystander treatments to subpar in-hospital care. Many suggestions have been made for how to improve national awareness of OHCA and the importance of bystander CPR knowledge. Basic CPR training is now part of the high school curriculum in 39 states but not in several states with low survival rates.^{1,39} Universal CPR education, using a standardized curriculum including AED training, within the public high school curriculum would partially alleviate the financial and educational barriers to CPR training for minority communities.³⁹ Free public, bystander CPR education programs would also be beneficial for training renewal and could help to equalize training rates between low- and high-income communities. Additionally, given the extent of the current disparities, targeted CPR training for minority and low-income neighborhoods should also occur. Geospatial analysis shows promise as a method for identifying “high-risk” neighborhoods, defined as neighborhoods with higher-than-expected incidence of OHCA with corresponding low prevalence of bystander CPR.^{5,40} Health promotion campaigns in these high-risk communities could reach the people most at need quickly and efficiently. An approach similar to that used in the famous FAITH and barbershop studies, where trusted leaders (fellow churchgoers, barbers) promoted better hypertension management among their community members, could be taken instead to encourage CPR training.^{41,42} We propose that this intervention also involve local EMS agencies, so that greater familiarity, trust, and cultural understanding can be engendered between first responders and the communities they serve. Community policing between EMS agencies and their respective communities may lead to improved cohesion that could in turn yield better EMS response times (eg, more swift and accurate location of arrests within dense urban neighborhoods) and allocation of resources (eg, dispatching teams trained in advanced cardiac life support and multiple resuscitation techniques for an anticipated difficult resuscitation). Disseminating simplified material translated into multiple languages at training events could further promote an inclusive environment and improve CPR performance among people of diverse racial/ethnic backgrounds.^{18,20}

In addition to hosting more CPR training events for high-risk communities, augmenting the resources immediately available during a cardiac arrest to bystanders is crucial. Data have shown that bystanders find 911 dispatcher CPR instructions helpful, but that these are not always provided during calls concerning for a cardiac arrest.⁴³ Enabling dispatchers to play prerecorded messages over the phone with general CPR instructions, translated into select languages, could abet bystanders during the initial moments of an arrest.⁴³ More publicly available, visible AEDs in areas with lower SES would also be beneficial. An approach similar to the Save-A-Life initiative in Singapore, where AEDs are installed at public housing blocks, could be

undertaken within high-risk communities to increase usage.⁴⁴ Moreover, family and close associates of people at high risk of cardiac arrest, such as patients with underlying heart or lung disease or pediatric patients with congenital heart disease, should be given express training in CPR.⁴³ Routine doctors’ visits may be an opportune time to provide this training.

For care provided by EMS and within hospitals postresuscitation, pinpointing specific interventions is difficult given a lack of data examining these variables. However, high-quality EMS resuscitation can be provided for all communities through implementing standardized training for paramedics, technicians, and other first responders throughout the United States, which should include training in basic and advanced cardiac life support updates, new resuscitation techniques such as field hypothermia, and best practices for transport to hospitals following return of spontaneous circulation. Increased funding to EMS agencies in need of more personnel or equipment, as well as to agencies that serve a higher percentage of low-income and minority populations, should be urgently provided. To help eliminate racial disparities in survival from in-hospital care, universal postresuscitation protocols may need to be devised to eliminate inefficiencies and ensure appropriateness of care.

Combining many of the initiatives described previously, a multistate quality improvement program known as the Heart-Rescue Project was initiated in 2010.⁴⁵ In North Carolina, the program allowed for increased CPR and AED training for community members, training for medical dispatchers in the recognition of cardiac arrest and provision of CPR instructions, training in high-performance CPR for first responders, and establishment of postresuscitation hospital protocols for percutaneous coronary intervention, targeted temperature management, and intensive care neurorehabilitation.⁴⁵ Despite these coordinated efforts to improve cardiac arrest outcomes for communities across the state, a large retrospective study showed that survival to discharge only increased significantly for White patients. However, rates of bystander CPR and defibrillation increased for both Black and White patients, and rates of survival following a shockable rhythm improved for both types of patients as well. These data suggest that increased resuscitation training improved outcomes as a whole and bridged the racial divide for survival for shockable rhythms, though nonshockable rhythms were still common in the Black community and survival from these remained low. Future efforts should also be targeted toward improving survival outcomes from nonshockable rhythms and treating their underlying causes.

Conclusion

In this review, we show that the racial, ethnic, and socioeconomic composition of neighborhoods within the United States plays a significant role in the likelihood that a patient will survive an out-of-hospital cardiac arrest. Black and Hispanic patients living in under-resourced neighborhoods are much less likely to survive from OHCA compared to their

White counterparts. The likelihood of survival suffers from peril at multiple steps, from initial poor recognition of cardiac arrest and provision of bystander CPR, to less use of AEDs, to lower-quality postresuscitation care. This reality for minority patients is especially important to consider in the midst of the COVID-19 pandemic, an illness that has impacted minority communities disproportionately and has also caused a rise in the overall incidence of OHCA.⁴⁶ To protect these high-risk communities going forward, greater community outreach is necessary, with instructions in bystander CPR and AED usage that are linguistically and culturally appropriate. EMS resuscitation and hospital postresuscitation protocols must also be reviewed, revised, and standardized to ensure efficiency and accuracy.

Funding Sources: This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Disclosures: The authors have no conflicts of interest to disclose.

Authorship: All authors attest they meet the current ICMJE criteria for authorship.

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