2018 Annual Report

CARES
Cardiac Arrest Registry
to Enhance Survival

Firefighter paramedics from Lincoln Fire & Rescue in Nebraska participate in a training exercise on the provision of post-resuscitative care.
Photo courtesy of Lincoln Fire & Rescue; Photo credit: Kelly Day Photo LLC.

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Cover photo courtesy of AMR San Francisco; Photo credit: Paramedic Jack Simpson.

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Introduction

EMS treated out-of-hospital cardiac arrest (OHCA) affects more than 240,000 Americans each year and is the third leading cause of disability adjusted life years (DALY) in the United States, behind cardiovascular disease and back pain. Typically, one in ten patients survives to hospital discharge, with 80% having no or moderate neurological disability. Cardiac arrest resuscitation is an important measure of a community's emergency response readiness. Successful resuscitation requires involvement by a range of individuals including bystanders, emergency medical dispatchers, first responders, paramedics, and hospital providers. Performing bystander CPR can nearly double survival and public access defibrillation results in an almost 50% survival rate for patients presenting in a shockable rhythm. It's important to remember that these impactful community based interventions happen in advance of 911 responders arriving on the scene.

Measurement is key to improving quality of care and patient outcomes. In 2015, the Institute of Medicine released "Strategies to Improve Cardiac Arrest Survival: A Time to Act," which recommended the establishment of a national cardiac arrest registry to monitor performance in terms of both success and failure, identify problems, and track progress[1].

The Cardiac Arrest Registry to Enhance Survival (CARES) allows communities to benchmark their performance with local, state, or national metrics to better identify opportunities to improve their OHCA care. CARES offers a comprehensive understanding of where arrests are occurring, whether bystanders are providing intervention prior to EMS arrival, EMS and hospital performance, and patient outcomes. This in turn provides the data necessary to make informed decisions and allocate limited resources for maximal community benefit. By creating an easy-to-use and flexible system to collect OHCA data and forming a community to share best practices, CARES has transformed the way EMS agencies are treating cardiac arrest. Participating agencies are able to make decisions in their community based on real-time feedback and analysis, in order to increase survival.

We sincerely appreciate the members of the EMS and hospital CARES communities, as well as the sponsors (American Red Cross, American Heart Association, Emory University Woodruff Health Sciences Center, and Stryker) who support our mission to save lives and improve patient care. We are pleased to present the 2018 Annual Report.

Paramedics from Cabarrus County EMS in North Carolina complete checkoff to prepare for their shift.
Photo courtesy of Cabarrus County EMS.

A Year in Review

Dear CARES Community,

We are pleased to share the CARES 2018 Annual Report which includes our most recent OHCA metrics and several community based improvement activities. Contributions from Alaska, Colorado, Delaware and Ohio provide a snapshot of some of the "measure and improve" activities that are strengthening the "chain of survival" for patients locally. We also appreciate former Governor Tom Ridge sharing his Story of Survival.

Our goal of onboarding all 50 States in advancing CARES as the National Cardiac Arrest registry is aligned with our mission and vision goals.

MISSION: To help communities determine standardized outcome measures for out-of-hospital cardiac arrest allowing for quality improvement efforts and benchmarking capability to improve care and increase survival.

VISION: To become the standard out-of-hospital cardiac arrest registry for the United States allowing for uniform data collection and quality improvement in each state and nationally.

This year's report also recognizes the significant regional variation in OHCA patient outcomes between communities in the United States. There is a 5-fold difference in overall survival and 6-fold difference in bystander CPR provision in communities that have at least 150 cases a year (see page 36). Neighborhood disparity also exists and has been associated with socio-economic realities. In a recent CARES publication focusing on pediatric OHCA, Dr. Maryam Naim and colleagues found that "Racial and neighborhood characteristics are associated with bystander CPR in pediatric OHCA. Targeted CPR training for non-white, low-education and low-income neighborhoods may increase BCPR and improve pediatric OHCA outcomes".

This represents both a challenge and an opportunity for communities to develop and implement improvement activities focused on increasing bystander CPR compliance and minimizing the delay between initial patient collapse and first chest compression. Effective telephone-CPR education for dispatchers and quality improvement follow-up using the CARES T-CPR module are available and logical for communities to implement. New Castle County EMS's efforts in Delaware toward developing a successful program are highlighted in this issue (see page 17). We believe more communities need to adopt their own programs and fortunately, the NHTSA Office of EMS has recently developed an open source national curriculum (http://www.ems.gov/projects/cpr-lifelinks.html) as a blueprint to get communities started. The percentage of OHCA cases recognized by the telecommunicator, time to first instruction, and time to first compression are three telephone CPR metrics that every community should consider tracking locally in the near future if not already.

Adopting a "measure and improve" approach locally can be the first step in increasing a patient's chances of surviving an OHCA event while also addressing disparity concerns. We hope you enjoy the 2018 report and look forward to your feedback.

Respectfully,

Bryan McNally, MD, MPH
Executive Director CARES
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Why CARES Matters: A Story of Survival from OHCA

A Grateful Governor Tom Ridge Arrests Three Times and Lives to Tell About It

By Rick and Jennifer Chap, Co-Founders BuddyCPR, OHCA survivor and TCPR lay rescuer

In November 2017, Governor Tom Ridge experienced an out-of-hospital cardiac arrest while staying at the JW Marriott in downtown Austin, Texas. This January, Governor Ridge returned to the same hotel to give the keynote address at the 2019 National Association of EMS Physicians (NAEMSP) Annual Meeting. While there, he expressed his gratitude to the first responders from Austin Fire Department and Austin-Travis County EMS who saved his life. As a sudden cardiac arrest survivor, Ridge encourages fellow governors and legislators to recognize the lifesaving benefits of CARES to your state, your citizens, your communities and your loved ones.

Governor Tom Ridge is grateful to well-trained EMS first responders who saved his life from cardiac arrest: 'They never gave up on me'

Governor Tom Ridge, or "Gov" to his friends, is no stranger to public service. Safety and security are part of the DNA of this decorated soldier, six-term congressman, two-term governor, and most notably, the first Secretary of Homeland Security. Usually in the role of protecting others, this time it was he who needed help.

November 16, 2017 was a day Gov. Ridge will never forget, although he has little memory of it. He was attending the Republican Governors' Association meeting in Austin. On that morning, he awoke in his hotel room about 6:30, his normal time—but all was not normal. "I didn't feel well… I felt different," he reflects. "I felt a little pressure. I felt a little lethargic. I hadn't experienced these sensations before."

Ridge grabbed his iPhone and began Googling symptoms. Initially dismissive until the pressure worsened, he found an online checklist. After mentally ticking all the boxes, he concluded, "I might be having a heart attack." By now his symptoms were escalating rapidly. Struggling to get out of bed, he made it to his desk, called hotel reception for help, and the phone dropped to the floor.

Within minutes, Ridge suffered an out-of-hospital cardiac arrest (OHCA). His heart stopped beating. He was not breathing. This patriot, statesman, husband, father, brother and beloved friend was clinically dead.

First on the scene were Marriott employees and the EMT assigned to the conference. "They were able to get to me within probably a minute or two," stresses Ridge. Like so many survivor stories, people at the scene took immediate action. Within three minutes of the call to 911, the Austin Fire Department crew arrived. CPR (cardiopulmonary resuscitation) to push oxygenated blood to his brain and use of an AED (automated external defibrillator) to shock his heart were almost immediate—critical actions required for survival.

Ridge arrested three times prior to arriving at Dell Seton Medical Center—first in his hotel room, again in the elevator and once more in the hotel lobby. After the first resuscitation: "They asked me where I was… I'm pretty sure I said China," he quips. In all, responders worked on the governor for more than an hour, taking turns pumping his chest. He shares with not even a hint of complaint they "broke a bunch of ribs" to keep him alive.

"Without these highly competent, experienced, motivated personnel from the Austin-Travis County team… I'm dead," he remarks matter-of-factly. "They treated me as if I was their father, their brother, their best friend, and yet I was a total stranger. And they brought the intensity they would bring to saving the life of a loved one… They never gave up on me."

'I woke up five days later'

In addition to first responders, Ridge credits his survival to the post cardiac arrest advanced care he received from incredible healthcare professionals at the hospital. "They told my wife 'We have no idea what his cognitive state will be, what his physical state will be,'" he expresses with emotion the difficulties family members of OHCA victims face. "If truth be known, I was given last rites… And, trust me. I needed them."

He has no recollection of the event. "What I know is that I woke up five days later hooked up to everything imaginable," he says. The first person who came to mind he reports unequivocally, "First person, my wife…"

Ridge's strength and optimism are undeniable, and so too is his love of family. "Well this is a personal story. I love this because it involves people I love dearly," his voice smiles. "I remember when I finally became conscious, I thought I was dreaming and saw my sister in my dreams. Later I saw my son. I'm thinking… what are they doing here?" Ridge's sister was the first family member he remembers speaking with. "She sat next to me and gave me a kiss," he recalls, citing how comforting that was. "I have no better friends than my brother and sister."

Ridge admits it took him a day or two to figure out what happened. But his sense of humor was never lost: "The doctor told me I said, 'Well, I'm glad Saint Peter was a fisherman who believed in catch and release.'"

Ridge has responded to his brush with death with grace and steady resolve. He sums up his gratitude this way:

> *"First you're given the blessing of surviving that arrest. And, the second blessing is that there's no cognitive impairment, and you can understand and appreciate what happened and the severity of it all. You can also in time appreciate the fact that it will be difficult, but because there's no cognitive limit, you're given the opportunity, in time, to work yourself back. And that's another blessing."*

'It's a killer or a disabler.'

Ridge is one of the lucky ones. More than 1,000 people a day suffer OHCA in the US annually, and less than less than 1 in 10 survives, according to data from the Institute of Medicine. However, cities like Austin who measure for improvement have higher save rates. Austin has been using CARES to improve its response to OHCA since 2006. Dr. Mark Escott, EMS System Medical Director, City of Austin-Travis County points out, "The availability of the CARES data allows for us to continuously assess the strengths and weaknesses of our entire chain of survival for cardiac arrest in the City of Austin. Several years ago, through analysis of our data, we were able to identify a concern in our resuscitation system… modifications were made resulting in a significant improvement in the survival from cardiac arrest in Austin."

Ridge agrees. "The story is that there's a high rate of cardiac arrest and cardiac conditions," he says. "It's a killer or a disabler." He stresses the importance of CARES across all 50 states to reduce the tragic impact OHCA has on communities, citing the return on investment is worth it:

> *"$15,000 a year out of your public health budget involving a killer? More people die in every state because of that condition [OHCA], than from autos, guns and drugs. So why wouldn't we want to do it? I mean, I think it's a very appropriate ask. And, in the era of big data, it helps you refine procedures, improve response and response time and save lives."*

In addition to CARES, Ridge recognizes the importance of community awareness, CPR training and access to AEDs. Ridge says he is "fascinated" by the dispatch-assisted CPR movement, "Put it on speakerphone and follow me!"

'I'm just grateful to have another day'

Reflecting on his own survival Ridge concludes, "When we think about EMS, it is a chain of people connected to the response and recovery operation that is very significant. And unless they work in harmony and flawlessly, you don't have the outcomes…"

Ridge got that flawless harmony in Austin. Dr. Escott agrees, "Through the strengthened links in the chain of survival, Gov. Ridge survived and continues to serve and lead."

"I've had a blessed life," Ridge says. "I'm just grateful to have another day and to do the best I can with that day. I think that was on my mind before, but it's much deeper now, that's for sure."

Gov. Ridge thanks responders from Austin Fire Department and Austin-Travis County EMS for saving his life from cardiac arrest. Photo courtesy of NAEMSP.

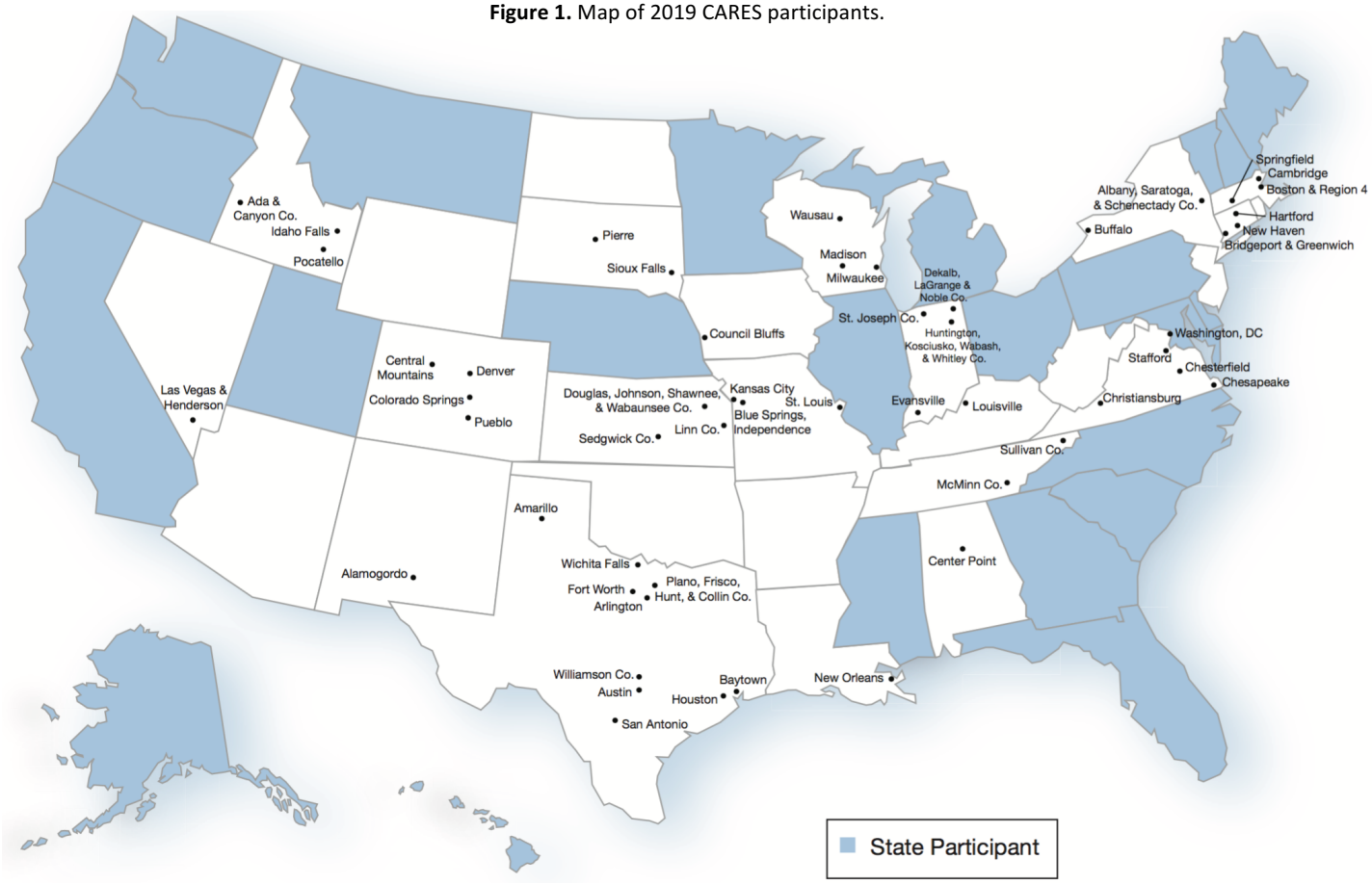
Firefighters from Perris City Fire Station #101 respond to an out-of-hospital cardiac arrest.
Photo courtesy of CAL FIRE/Riverside County Fire Department.

The Cardiac Arrest Registry to Enhance Survival (CARES)

In 2004, the Centers for Disease Control and Prevention (CDC) established the Cardiac Arrest Registry to Enhance Survival (CARES) in collaboration with the Department of Emergency Medicine at the Emory University School of Medicine. CARES was developed to help communities determine standard outcome measures for out-of-hospital cardiac arrest (OHCA), by linking the three sources of information that define the continuum of emergency cardiac care: 911 dispatch centers, emergency medical services (EMS) providers, and receiving hospitals. Participating EMS systems can compare their performance to de-identified aggregate statistics, allowing for longitudinal benchmarking capability at the local, regional, and national level.

CARES began data collection in Atlanta, with nearly 1,500 cases captured in 2006. The program has since expanded to include 23 state-based registries (Alaska, California, Delaware, Florida, Georgia, Hawaii, Illinois, Maine, Maryland, Michigan, Minnesota, Mississippi, Montana, Nebraska, New Hampshire, North Carolina, Ohio, Oregon, Pennsylvania, South Carolina, Utah, Vermont, and Washington) and the District of Columbia, with more than 70 community sites in 19 additional states. CARES represents a catchment area of almost 130 million people or approximately 40% of the US population. To date, the registry has captured over 425,000 records, with more than 1,700 EMS agencies and over 2,100 hospitals participating nationwide.

Figure 1. Map of 2019 CARES participants.



Case Definition

CARES captures data on all non-traumatic out-of-hospital cardiac arrests where resuscitation is attempted by a 911 Responder (CPR and/or defibrillation). This also includes patients that receive an AED shock by a bystander prior to the arrival of 911 Responders. Inclusion and exclusion criteria are described below (Tables 1 and 2).

Table 1. CARES inclusion criteria (all of the following)
• Patients of all ages who experience a non-traumatic, out-of-hospital cardiac arrest.
• Patients who are pulseless on arrival of 911 Responder; OR • Patients who become pulseless in the presence of 911 Responder; OR • Patients who have a pulse on arrival of EMS, where a successful attempt at defibrillation was undertaken by a bystander prior to arrival of 911 Responder.

Table 2. CARES exclusion criteria (any of the following)
• Unworked/untreated cardiac arrests, to include codes that are terminated immediately upon arrival of EMS because the patient is not a viable candidate for resuscitation due to: ○ Injuries incompatible with life. ○ The presence of rigor mortis or lividity. ○ Signs of decomposition. ○ Presence of a valid DNR.
• Private EMS transport that did not involve 911 dispatch.
• Cardiac arrest of clear and obvious traumatic etiology.
• Bystander suspected cardiac arrest, where ROSC was achieved without the need for defibrillation or 911 Responder CPR.

Data Collection & Elements

Data collection within CARES is based on the Utstein-style definitions – a standardized template of uniform reporting guidelines for clinical variables and patient outcomes that was developed by international resuscitation experts[2,3].

The CARES web-based software (https://mycares.net), links three sources to describe each OHCA event: 1) 911 call center data, 2) EMS data, and 3) hospital data. Data can be submitted in two ways: using a data-entry form on the CARES website, or via daily upload from an agency's electronic patient-care record (ePCR) system. Access to the CARES website is restricted to authorized users, who are prohibited from viewing data from another agency or hospital.

Data elements collected from EMS providers include demographics (i.e. name, age, date of birth, incident address, sex, and race/ethnicity), arrest circumstances (i.e. location type of arrest, witness status, and presumed etiology), and resuscitation-specific data (i.e. information regarding bystander CPR initiation and/or AED application, defibrillation, initial arrest rhythm, return of spontaneous circulation [ROSC], field hypothermia, and pre-hospital survival status).

EMS providers are also able to enter a number of optional elements, which further detail arrest interventions (i.e. usage of mechanical CPR device, ITD, 12 Lead, automated CPR feedback device, and advanced airway; administration of drugs; and diagnosis of STEMI). The CARES form includes a number of optional time elements, including estimated time of arrest, defibrillatory shock, and initial CPR. Supplemental data elements collected from the 911 call centers include the time that each 911 call was received, the time of dispatch for both first responder and EMS providers, and arrival time at the scene.

Data elements collected from receiving hospitals include emergency department outcome, provision of therapeutic hypothermia, hospital outcome, discharge location, and neurological outcome at discharge (using the Cerebral Performance Categories [CPC] Scale). Receiving facilities may also complete optional elements outlining hospital procedures, including coronary angiography, CABG, and stent or ICD placement.

The CARES dataset is geocoded on an annual basis, and linked to a number of census-tract level variables including: median household income, median age, race/ethnicity, unemployment rate, poverty status, urbanicity, and educational attainment.

Reporting Capability

The CARES software includes functionality to automate data analysis for participating EMS agencies. The reports include 911 response intervals, delivery rates of critical interventions (i.e. bystander CPR, dispatcher CPR, public access defibrillation [PAD]), and community rates of survival using the Utstein template. An EMS agency has continuous access to their data and can generate reports by date range at their convenience. The software is also capable of aggregate reporting such that CARES staff can generate custom reports for benchmarking and surveillance purposes. In addition, hospitals have access to facility-specific reports, allowing users to view pre-hospital and in-hospital characteristics of their patient population with benchmarking capability. A robust query feature also allows agencies and hospitals to create customized searches of their data. These search results can be easily exported to Microsoft Excel for further analysis.

Data Validation

The CARES quality assurance process is one of the strengths of the registry, as a number of measures are taken to ensure the integrity and accuracy of the data. These measures include standardized training of all CARES users, built-in software logic, an audit algorithm ensuring consistent data validation across the registry, and a bi-annual assessment of population coverage and case ascertainment.

Training, Education, and Support

Training, education, and ongoing technical and operations support are key components of CARES that contribute to the registry's success and enhance the experience for participating sites. During the enrollment process, EMS and hospital users receive extensive training from CARES staff on the data elements, data collection process, and features of the CARES website. This training includes a one-on-one session with a CARES Program or State Coordinator prior to being granted access to the software. EMS and hospital users are also provided with numerous resources, including a detailed CARES data dictionary and a CARES user guide. Once a community has been participating in the registry for an extended period of time, CARES provides ongoing support in the form of answering questions as needed, providing updated training documents, and responding to individual reporting requests.

Software Logic and Auditing

In order to provide consistent data validation across the registry, each CARES record is reviewed for completeness and accuracy through an automated audit algorithm. Once the record is processed by the algorithm, data entry errors are flagged for review by EMS and hospital users (as appropriate) and CARES staff. Logic and error messages are also incorporated into the data-entry form to minimize the number of incomplete fields and implausible answer choices during the data entry process. Finally, aggregate data is analyzed on a regular basis to identify agency-specific anomalies. CARES staff utilize site-by-site comparison tools to detect outliers and compare each agency's data with the national average.

Case Ascertainment

Each EMS agency is asked to confirm their non-traumatic call volume to ensure capture of all arrests in a defined geographic area. The volume of OHCA per month is compared with historic monthly volumes by CARES staff; when a substantial drop in the number of events occurs, the EMS contact is notified to determine if the variation was real or the result of a lag in the data-entry process. In addition, CARES conducts a bi-annual assessment of population coverage and case ascertainment. CARES staff and State Coordinators provide each EMS agency's geographic coverage, census population, and start date via a standardized template. This information is then linked with record volume to identify outliers across the entire registry. In the event that an outlier is found, CARES staff or the State Coordinator works closely with the EMS agency to identify any issues in the data collection process and resolve as needed.

An ambulance is prepared for patient transport in Delaware, Ohio.
Photo courtesy of Delaware County EMS.

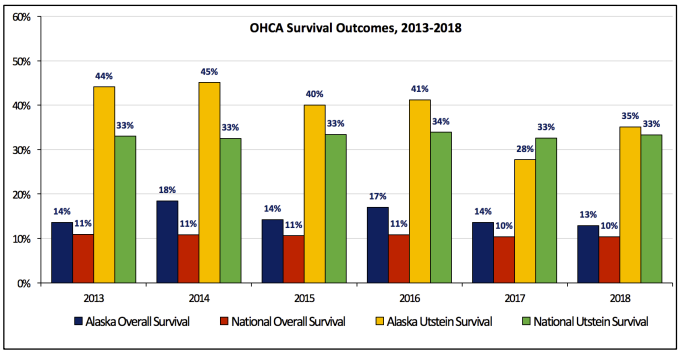
CARES in Action

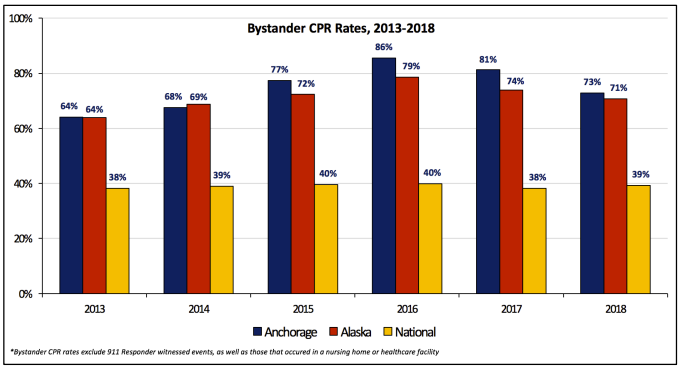
The Alaska CARES Experience: 6 Years of Measure and Improve

By Jenny Shin, MPH, Alaska CARES Coordinator
Dr. Mike Levy, MD, Medical Director, Alaska Section of Rural and Community Health Systems

Nationwide, there can be as much as a ten-fold difference in the likelihood of surviving an out-of-hospital cardiac arrest (OHCA) depending upon the community in which it occurs. Communities with better outcomes are those that have instituted a chain of survival to include participation in a data registry which allows objective monitoring of outcomes, as well as the metrics associated with improvement in those outcomes. The utility of a registry such as CARES was emphasized by a recent National Academies of Sciences report in which a cardiac arrest registry was recognized as an important tool for improving OHCA survival.

The Municipality of Anchorage has participated in CARES for over a decade and has achieved survival outcomes that have exceeded the national average. Over the past 6 years, a growing number of Alaska communities have joined the registry as a result of the HeartRescue effort to improve outcomes from OHCA, and we now estimate that over 80% of the state's population lives in an area covered by an agency participating in CARES. The expanded availability of these data has helped communities focus on opportunities for system improvements that could ultimately translate into lives saved. Over a six-year period, from 2013-2018, both Anchorage and Alaska have achieved above average rates of overall survival, Utstein survival, and bystander CPR provision. Examples of state-level monitoring and benchmarking are included in the figures to the right. Alaska's overall statistics show some anticipated fluctuations in the years during which we on-boarded newer systems, since earlier years largely reflected Anchorage's performance. This helps to illustrate the challenges associated with providing care for OHCA in rural areas and the statistical effects of lower volume systems.





CARES registry data can also highlight specific parts of the chain of survival in need of improvement. The five links in the chain of survival are early access to care, early CPR, early defibrillation, rapid delivery of EMS care, and early post-resuscitative care. For example, CARES data were useful for the Anchorage Fire Department in determining that their 911 response system needed to be improved to achieve better outcomes. In the past, the department used a standard proprietary system for 911 call-taking, including the provision of dispatcher-assisted CPR. Initially, the goals of achieving shorter times to CPR and increasing bystander participation were not being met. A different system was adopted in May of 2014 that included Criteria Based Dispatch (CBD) and utilizing the CARES Dispatcher Assisted CPR module to track numerous time intervals as well as monitor barriers encountered by the dispatcher. Subsequent review showed a considerable decrease in time to dispatcher recognition of cardiac arrest, decrease in time to first chest compression, and higher compliance with bystander CPR.

In conclusion, the CARES registry is a vital source of actionable information for improving survival from OHCA by addressing those links in the chain of survival showing the greatest opportunity for improvement. Various metrics can be obtained to review a range of factors involved in OHCA survival including response times, community engagement, bystander CPR training, and circumstances where laypersons identified OHCA early enough to activate the chain of survival in a timely manner. Stakeholders are encouraged to review data that are specific to their own systems/communities to identify areas of success and areas in need of improvement. Agencies and hospitals should review their outcomes data over time to identify temporal trends. Such reviews can be useful for establishing new benchmark goals to further improve survival rates.

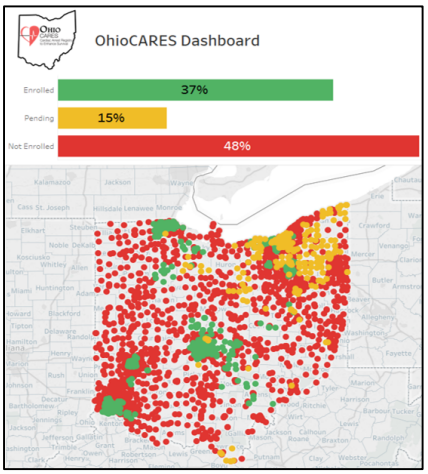
From Agency to State Implementation in Ohio

By Dr. David Keseg MD, FACEP, FASAM, Medical Director, Columbus Division of Fire, Columbus, OH

In 2007, the Columbus Division of Fire had a problem. We wanted to improve our survival rates from sudden cardiac arrest, but didn't have any idea what our current survival rates were. We attempted to set up a local registry, but it was too resource intensive. When I attended an EAGLES EMS conference and heard about the Cardiac Arrest Registry to Enhance Survival (CARES) program that was expanding outside of the metro Atlanta area, I knew we had our answer.

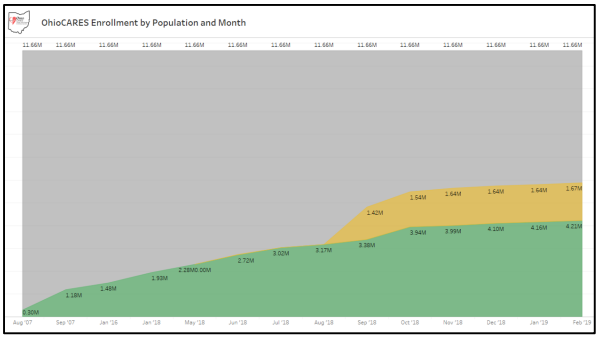
Columbus Division of Fire began CARES participation in September 2007 and has been collecting OHCA data for more than 10 years. Through CARES, we are able to obtain precise, real-time measurements on critical community components like bystander CPR and AED use, as well as identify geographic areas with high risk for sudden cardiac arrest and low bystander CPR and AED utilization, which has allowed us to allocate our resources for maximal impact. We have been able to see the direct benefit of programs like pit crew CPR training and strategic AED deployment in our community. Over our numerous years of participation, we have experienced many improvements including increases in bystander CPR and our Utstein survival rates.

In 2016, a group comprised of key stakeholders from existing CARES participants and local EMS leadership began exploring the potential of enrolling Ohio as a CARES state participant. As a first step, this group of stakeholders committed to monthly calls in order to work through the infrastructure and financial needs for participation. Second, we developed a letter requesting funding support for the program and shared it widely with our State EMS Office, Academic Medical Centers, Hospitals and non-profit groups in the state. In parallel, we received commitment from the existing CARES participants in the state to donate the following year's subscription fee towards the initiative. Third, we tasked ourselves with identifying a potential human resource "home" for the state coordinator. We also created an Ohio-CARES website to begin marketing the project and host easily accessible resources for interested agencies. In addition, we partnered with the HeartRescue project and AHA to assist in the implementation of resuscitation academies around the state, to both encourage CARES participation and work towards improving the professional EMS response to cardiac arrest. And lastly, we created the Ohio-CARES Board that would oversee the various aspects of state participation.



The state of Ohio began state participation in January 2018. Our state coordinator is located at the Ohio State University (OSU) Center for EMS, and the Ohio Department of Public Safety (ODPS) has committed to covering the subscription fee for the initial 3 years of participation. In addition to the OSU Center for EMS and the ODPS, current funders include University Hospitals, the Cleveland Clinic, and Mount Carmel Health. We are grateful for the support that has allowed the vision of Ohio-CARES to become a reality. The stakeholder group and the Ohio-CARES Board continue to meet every other month to review CARES expansion, resuscitation academy plans, funding initiatives and other relevant topics as needed. (See examples of the Ohio-CARES expansion dashboard figures that are reviewed and discussed each call, to the left).

To date, Ohio-CARES has over 35% of the state population participating and has conducted five resuscitation academies throughout Ohio with another three scheduled through the end of 2019. We have found there is a direct correlation between agency engagement in making system improvements and participation in CARES and we incorporate this message into our resuscitation academies to encourage CARES participation. Our goal is to have 90% of our EMS agencies participating within the next 5 years and be designated as a HeartRescue state. We are hopeful that these efforts will result in an improvement in survival from sudden cardiac arrest in Ohio.



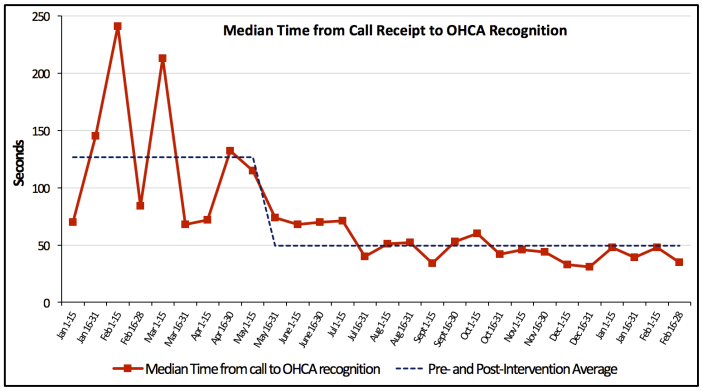
If you can't measure what you hope to improve, then it becomes impossible to achieve your goals. Signing-up for CARES all the way back in 2007 was one of the best things we have done in Columbus to enhance our survival from sudden cardiac arrest. Now the state of Ohio has taken the same step. Through the help of the program sponsors, partners and participants, we are on a mission to improving cardiac arrest survival in our state. Now every agency and community in the state has access to CARES and can benefit from both measurement and improvement to save countless lives in Ohio.

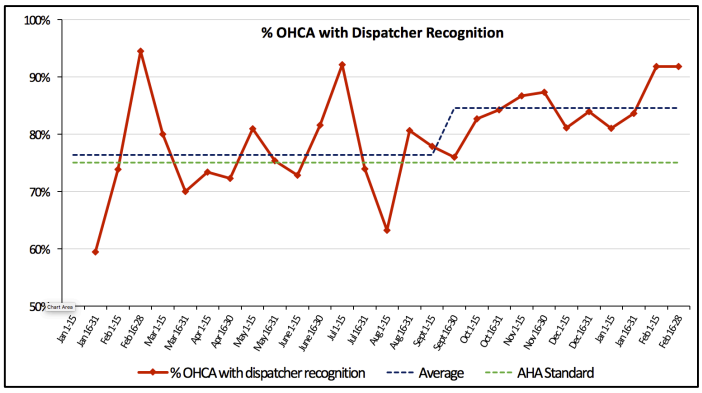
Using the CARES DA-CPR Module for Performance Improvement in New Castle County, Delaware

By Dr. Robert A. Rosenbaum, MD, Delaware Office of EMS, EMS Medical Director, New Castle County, DE

New Castle County (NCC) EMS in Delaware has been a CARES participant since 2009, and has seen significant increases in our OHCA survival rate over the past 10 years as a result of continuous performance measurement and practice modifications. Dispatcher Assisted CPR (DA-CPR) utilizing an emergency medical dispatch system (PMD) has been part of Communications practice for years. We took the next step in 2018, as the Emergency Communications Division, with clinical oversight from the County EMS Medical Director, Emergency Communications Chief and a performance improvement team from Emergency Communications added the CARES DA-CPR module to ensure 100% review of all cardiac arrest calls.

From January to April, baseline data were compiled with call review by shift supervisors who were trained in the DA-CPR data dictionary and data reporting process. The EMS Medical Director met with all four shifts of telecommunicators in late April to describe the performance improvement initiative that would work to improve DA-CPR and, correspondingly, overall rates of bystander CPR in New Castle County. The aim of the performance improvement project was to increase the frequency of bystander CPR for patients with OHCA, by targeting early dispatcher recognition of cardiac arrest and initiation of pre-arrival instructions.





Various methods were implemented, including but not limited to: trained supervisors reviewed 100% of OHCA calls, twice monthly progress reports with run charts and control charts were distributed for all metrics, and regular feedback from the EMS Medical Director was shared with all telecommunicators throughout the project either in-person at shift "roll calls" or electronically.

By the beginning of 2019, after a review of over 500 calls, all telecommunicator metrics showed improvement in median measurements during the post-intervention period. The greatest impact was seen in telecommunicator recognition time, which improved by over 1 minute. Bystander CPR performance improved in both the frequency of CPR and time to first compression, which decreased by nearly 30 seconds on average.

	Pre-intervention	Post-intervention
Recognition of OHCA by telecommunicator	76.3%	84.6%
Time to recognition of OHCA	127 seconds	50 seconds
Time to first compression	162 seconds	136 seconds
Bystander CPR after witnessed cardiac arrest	<45%	50%

NCC EMS and County Communications leadership considers this project to be a success that will allow for improved care for years to come, and improve the opportunity for countless lives to be saved in the community. The CARES DA-CPR module will continue to be utilized and tracked to ensure ongoing improvement and increases in survival.

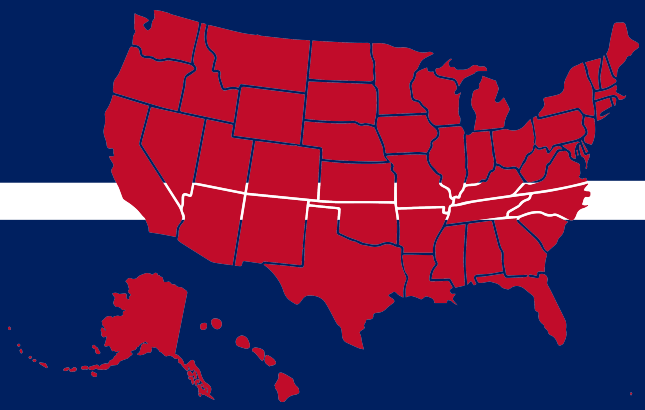
Managing Cardiac Arrest at Vail Ski Area – A Unique Environment

By Marc Burdick, NRP, Eagle County (CO) CARES Coordinator

Preparing and responding to sudden cardiac arrest (SCA) in any community is challenging. Implementing various response components, including community readiness, bystander CPR, public access defibrillation, high quality resuscitation, advanced and tertiary care and data utilization each contribute to more favorable patient outcomes. But what about SCA on a remote ski mountain at 11,000 feet in a snowstorm? Such is the case at Vail and Beaver Creek Ski Areas in Eagle County, Colorado. For the past 10 years, the professional ski patrols have partnered with local agencies to better prepare for and respond to sudden cardiac arrests on the mountain. These two world-class ski resorts can have as many as tens of thousands of skiers per day on the mountains, especially during busy holiday periods.

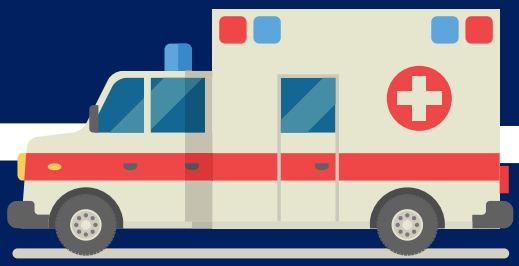
So how exactly do ski patrols respond to a SCA on the mountain? Typically, if someone collapses while skiing (or at one of the many on-mountain restaurants), a witness will call 911 or ski patrol dispatch. If 911 is called, the Vail Public Safety Communications Center will transfer the call to Vail Ski Patrol Dispatch and simultaneously provide telephone CPR instructions. Ski Patrol will dispatch multiple patrollers under a "Cardiac Dispatch" Protocol with each team member having a clear understanding of their role within the pit crew resuscitation model. Ski Patrol Dispatch will also attempt to locate one of 15 skiing paramedics and physicians by radio to respond. Ski patrollers work to quickly begin or continue high-quality CPR and expose the patient's chest for the AED, which can prove difficult under multiple layers of ski clothing. If available, a paramedic or physician arrives and provides ALS care. Ski Patrollers are trained and authorized to place a supraglottic airway. ALS care usually includes establishing vascular access, EKG interpretation, and ACLS medications. The patient is then placed into a dual rescue toboggan, AKA "cardiac rig" (pictured above), and skied by three ski patrollers to the base of the mountain where care is transferred to Eagle County Paramedic Services for transport to Vail Health Hospital, a short distance away. Vail Health Hospital is a Level 3 Trauma Center but also has something entirely unique in a ski town, an interventional cardiac catheterization lab under direction of cardiologist Dr. Jerry Greenberg. "I think we might be the only cath lab at the base of a major ski resort in the United States. We have had some great patient outcomes because of the teamwork from the ski patrollers all the way to the cath lab," said Dr. Greenberg, who also serves as a medical advisor to Vail Ski Patrol.

Eagle County Paramedic Services began participating in the CARES Program in 2016 under the support and partnership of Starting Hearts (https://www.startinghearts.org/), a local non-profit founded by Lynn Blake, herself a SCA survivor. Starting Hearts is dedicated to making Eagle County prepared for SCA through public access defibrillation and their innovative "*Call.Push.Shock*" CPR training program. Starting Hearts further partnered with Vail and Beaver Creek Ski Patrols to place 10 additional AEDs in strategic locations, such as remote ski lifts, to better prepare the mountains for SCA. Brice May, Director of Vail Ski Patrol, developed a "Guerilla CPR" program where ski patrol trainers "crash" staff meetings at the resort and provide CPR and AED training. Mr. May estimates that over 4,000 people have been trained to date. And it's working. Through CARES data analysis, Eagle County is recognizing that it has approximately 12% overall survival from SCA, but that the survival rate at Vail and Beaver Creek Ski Resorts during the 2016-2019 ski seasons was an outstanding 50% (4/8). Eagle County is using CARES data as an integral part of its SCA preparedness. CARES has been key to our understanding of why SCA patients do better at the ski resort than the overall community. We strive to get even better everywhere.



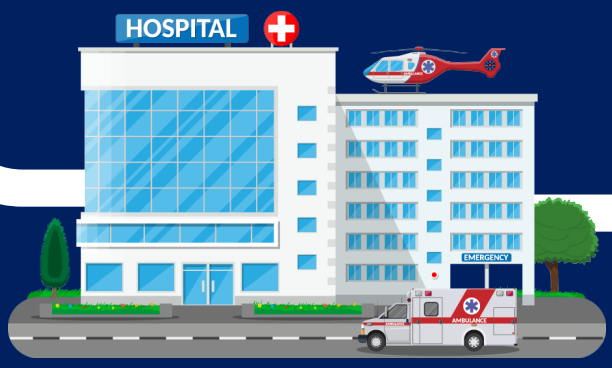
81,864 non-traumatic, worked OHCAs reported to CARES in 2018

39.2% of patients received bystander CPR



Median EMS response time:
7.5 minutes
31.1% of patients achieved sustained ROSC in the field

11.9% of patients who arrested in public had a bystander applied AED



28.2% of patients survived to hospital admission

44.5% of admitted patients received hypothermia care

10.4% of patients survived to hospital discharge

79.3% of discharged patients had a positive neurological outcome (CPC 1 or 2)

Incidence & Demographics

2018 Dataset and Incidence of OHCA Events

This report describes CARES data from the most recent calendar year, January 1 to December 31, 2018. CARES requires that an EMS Agency enter at least one complete calendar year of data and meet a patient lost to follow-up threshold of less than 1% to be included in the Annual National Report. The CARES 2018 National Reports can be viewed at: https://mycares.net/sitepages/reports2018.jsp.

Descriptive statistics in this report are presented as frequencies or proportions for categorical variables, and median and interquartile ranges for continuous variables. Comparison of proportions were conducted using the chi-square test.

The 2018 dataset includes 1,239 EMS Agencies and 1,412 Hospitals, and represents a population of 110.1 million, approximately 34% of the U.S. population. In 2018, 81,864 OHCA events were reported to CARES. The crude incidence of non-traumatic, worked arrests was 74.3 per 100,000, consistent with the incidence rate observed in 2017. Using 2018 census data to extrapolate to the U.S. population[4], CARES estimates that there were approximately 243,000 EMS-treated, non-traumatic OHCAs in the United States last year.

Demographics

In 2018, CARES patients were predominately male (62.1%). Of the reported OHCA events, 97.1% (n=79,490) were adults and 2.9% (n=2,340) were children, 18 years and younger. The median age of OHCA patients was 64.0 years (mean: 62.2; SD: 19.3). The age distribution varied significantly across the sexes (Figure 2), with females having a higher median age of arrest (66.0 vs. 63.0 years, p<.0001).

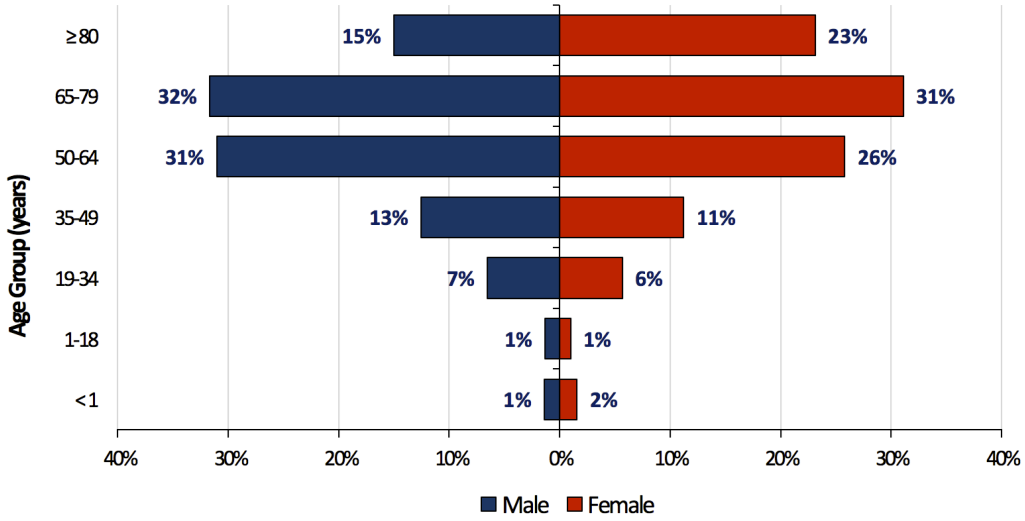


Figure 2. Age distribution of OHCA events.

Etiology

In alignment with the most recent ILCOR guidelines[3], CARES requires that all EMS-treated, non-traumatic cardiac arrests be entered into the registry. The etiology of arrest is identified by field providers and recorded in the patient care record. Per the Ustein guidelines, an arrest is presumed to be of cardiac etiology unless it is clearly documented otherwise.

In 2018, 82.7% of adult (>18 years of age) OHCAs were presumed to be of a cardiac cause. Other causes of adult OHCA were: respiratory/asphyxia (8.8%), drug overdose (6.1%), exsanguination/hemorrhage (0.8%), drowning/submersion (0.5%), and other medical (1.1%) (Figure 3).

The etiology of arrest for pediatric patients (≤18 years of age) differed substantially from that of adults. In 2018, 40.2% of pediatric arrests were presumed to be of a cardiac etiology. Other causes of pediatric OHCA were: respiratory/asphyxia (36.7%), drowning/submersion (9.0%), SIDS/SUID (7.5%), drug overdose (2.8%), and other medical (3.8%) (Figure 4).

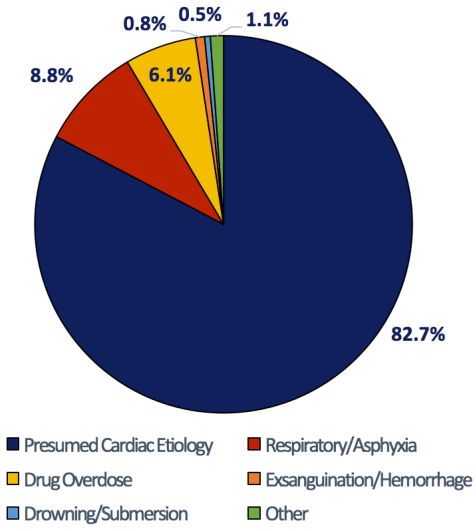


Figure 3. Etiology of arrest for adults.

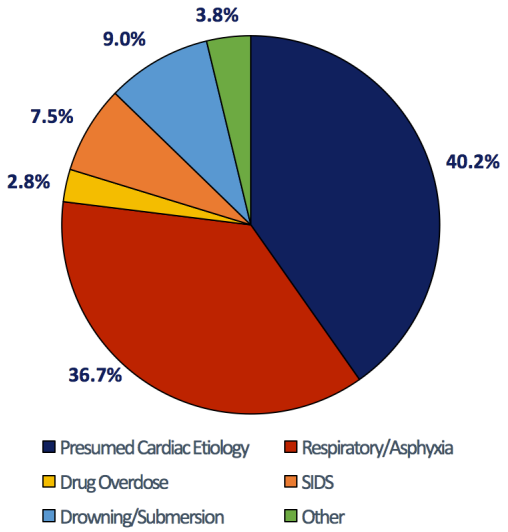


Figure 4. Etiology of arrest for pediatric patients.

Figure 5 further highlights the relationship between arrest etiology and patient age. Presumed cardiac cause was the most predominant etiology for all age groups, with the proportion of arrests attributable to this cause increasing with patient age. However, pediatric patients were much more likely than adults to experience an arrest due to respiratory cause. Drug overdose accounted for 41% of arrests in the 19-34 age group and 17% of arrests in the 35-49 age group, highlighting the impact of the current opioid epidemic in the United States.

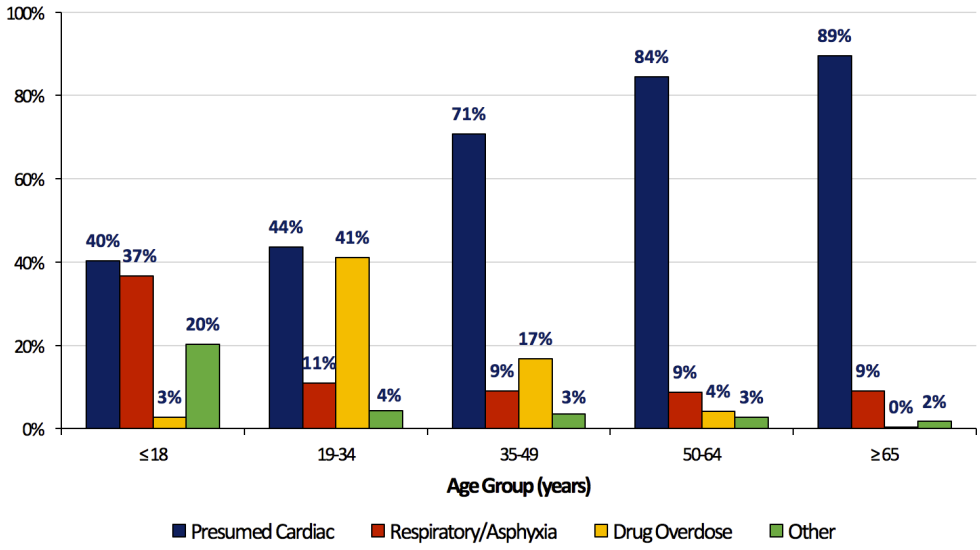


Figure 5. Etiology of arrest by age group.

Location of Arrest

The most common place for an OHCA to occur is in a residential setting, with 70.2% of events occurring in a home. Other common arrest locations were nursing home (11.1%), public or commercial building (7.5%), street or highway (5.0%), and healthcare facility (3.6%) (Figure 6).

The location of an OHCA is highly correlated with bystander intervention and patient outcome. In comparison to residential arrests, patients who arrested in a public setting were far more likely to have a bystander witnessed event and receive bystander CPR prior to EMS arrival (Figure 7). Patient outcomes were also significantly different across incident locations, with public arrests having a 2.5-fold rate of survival to hospital discharge compared to residential arrests (22.0% vs 8.5%, respectively; p< .0001).

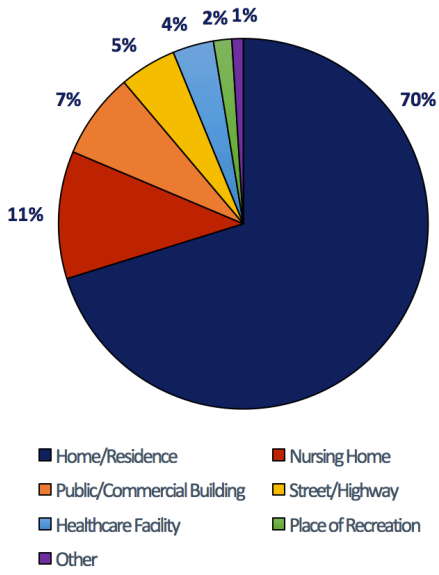


Figure 6. Location of arrest.

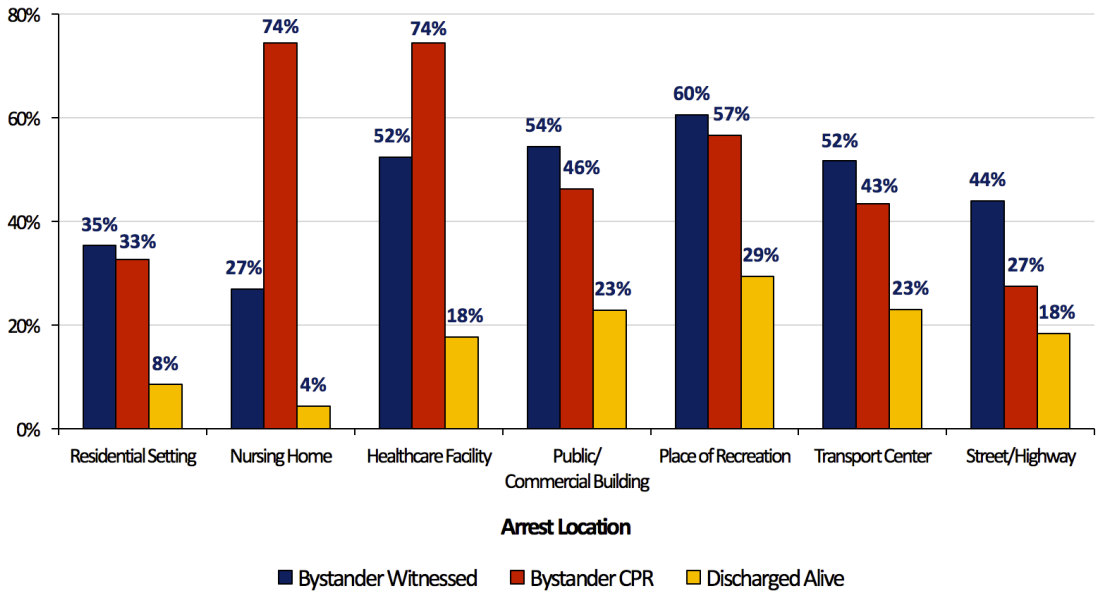


Figure 7. Percentage of events that are bystander witnessed, receive bystander CPR, and survive to hospital discharge by arrest location.

Witness Status

Arrest witness status has significant implications for patient outcomes, as witnessed arrests have more opportunity for bystander intervention and early delivery of care.

Approximately half of arrests were unwitnessed (50.1%), while 37.3% were bystander witnessed and 12.5% were witnessed by a 911 Responder (Figure 8). Patients with a bystander witnessed arrest were more than 3 times as likely to survive their event compared with unwitnessed arrests (15.8% vs 4.4%, respectively; p<.0001), while patients with a 911 Responder witnessed arrest were 4 times as likely to survive compared with unwitnessed arrests (17.9% vs 4.4%, respectively; p<.0001).

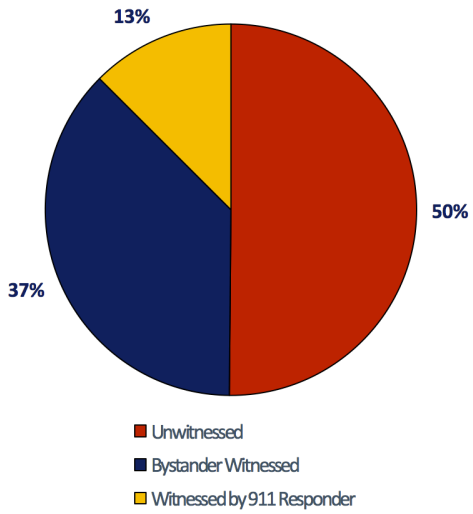


Figure 8. Arrest witness status.

Initial Rhythm

When the cardiac rhythm is first monitored after OHCA, a patient may present in a shockable rhythm (ventricular fibrillation or ventricular tachycardia) or non-shockable rhythm (asystole or idioventricular/pulseless electrical activity (PEA)). Treatment and prognosis depend on presenting rhythm, with better survival after OHCA among patients with a shockable rhythm (29.4% vs. 6.1%, p<.0001).

18.4% of patients presented with an initial shockable rhythm of ventricular fibrillation (VF) or ventricular tachycardia (VT), while 81.6% of patients presented in an unshockable rhythm, with asystole being the most common (50.3%). Presenting rhythm differed markedly by arrest witness status, with bystander witnessed patients being much more likely to present in a shockable rhythm than unwitnessed patients (29.6% vs 10.3%, respectively; p<.0001) (Figure 9).

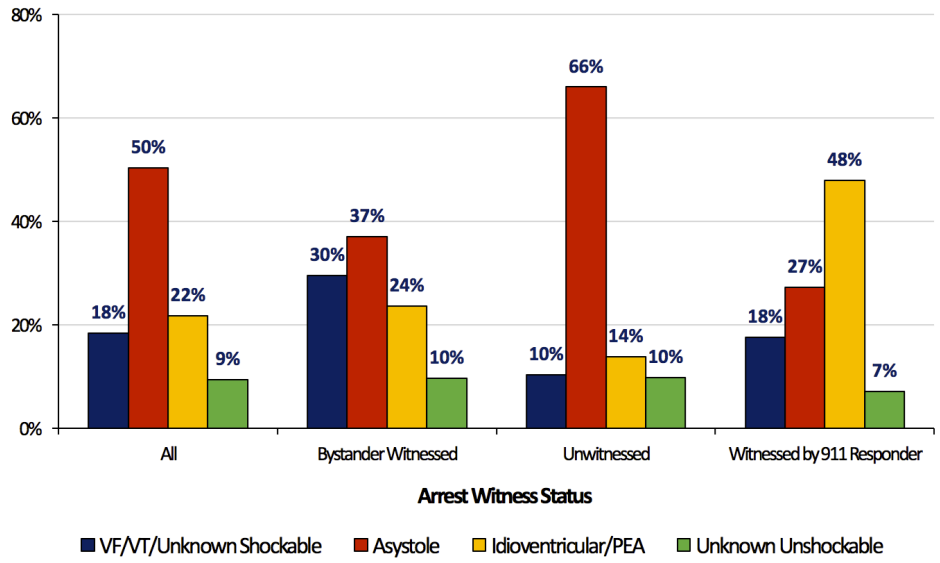
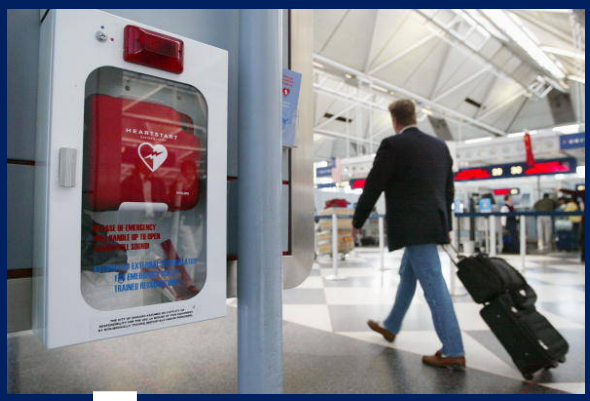


Figure 9. Presenting arrest rhythm by arrest witness status.

Early access to care

Early CPR



Early defibrillation

Rapid delivery of EMS care

Chain of Survival

The chain of survival refers to a series of actions intended to maximize the chances of survival following cardiac arrest. The five links in the chain of survival are early access to care, early CPR, early defibrillation, rapid delivery of EMS care, and early post-resuscitative care. For every minute of cardiac arrest without CPR or defibrillation, a patient's chance of survival falls by 7-10%[5]. This means that the community and bystander response are integral to survival from OHCA.

Early Access to Care

The first step in the chain of survival is recognition of cardiac arrest and activation of the emergency response system by calling 911. The next crucial time period is the interval between call receipt at the dispatch center to arrival on scene, or "response time". The distribution of First Responder and EMS response times are presented in Figure 10.

Response and treatment times are supplemental elements in CARES; however, participants are encouraged to measure response times in order to identify local opportunities for improvement. Records with missing response times (15.9%) as well as those that were witnessed by a 911 Responder (12.5%), have been excluded from response time analyses.

In 2018, median response time by First Responders was 6.4 minutes (IQR: 5.0 - 8.8 minutes) and median response time by EMS was 7.5 minutes (IQR: 5.5 - 10.2 minutes). First Responders arrived on scene in ≤ 5 minutes for 29.7% of arrests, while EMS arrived on scene in ≤ 9 minutes for 66.6% of arrests.

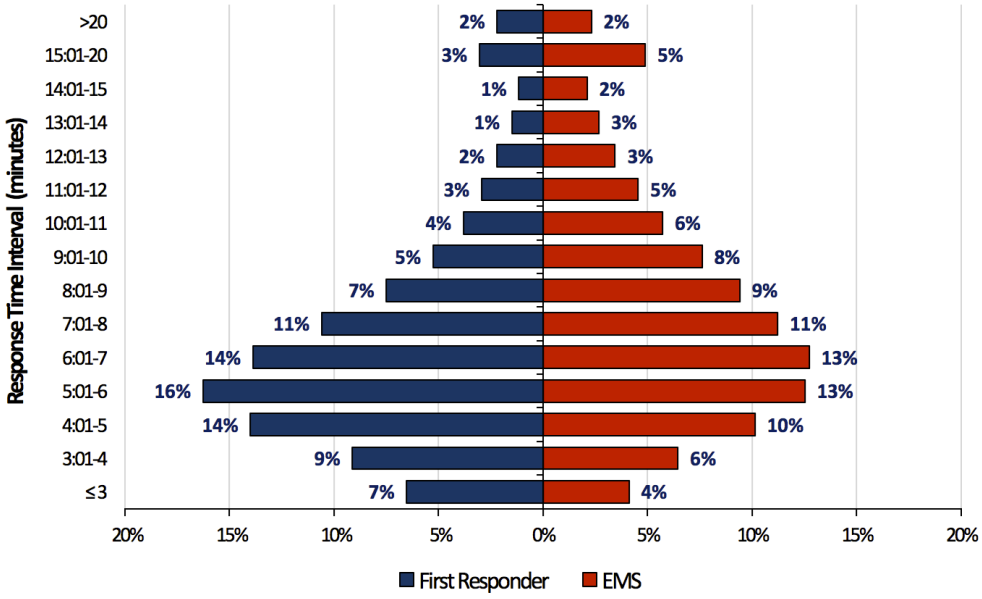


Figure 10. Distribution of First Responder and EMS response times (time interval from 911 call to arrival on scene).

Figure 11 is a bivariate analysis of survival to hospital discharge rate by EMS response time (measured from call receipt at dispatch center to arrival of the ambulance at the scene) for all OHCA patients as well as three subsets: bystander witnessed, bystander witnessed VF/VT (Utstein), and unwitnessed. Patients with a witnessed VF/VT arrest experienced a significant decrease in survival with increasing EMS response time. In contrast, response time had little effect on survival among unwitnessed arrests.

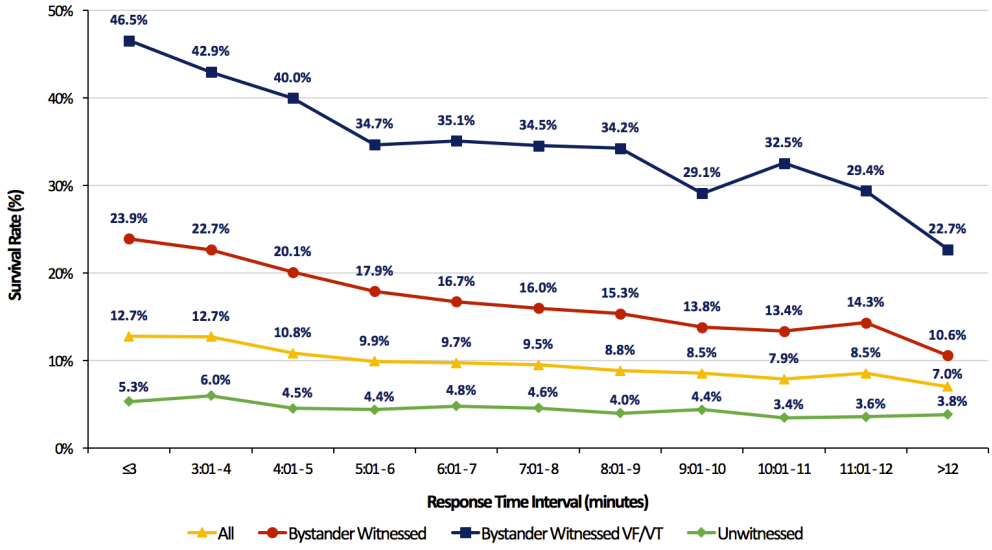


Figure 11. Survival rate by EMS response time and arrest witness status.

Figure 12 illustrates the interdependence between the links in the chain of survival, by highlighting how rapid 911 response and bystander CPR (bCPR) work in tandem to improve patient survival. Bystander CPR helps provide critical and timely intervention while 911 vehicles are in transit to the scene. By comparing the same patient subgroups in Figure 11 and Figure 12, one can see how survival is elevated when bystander CPR is performed.

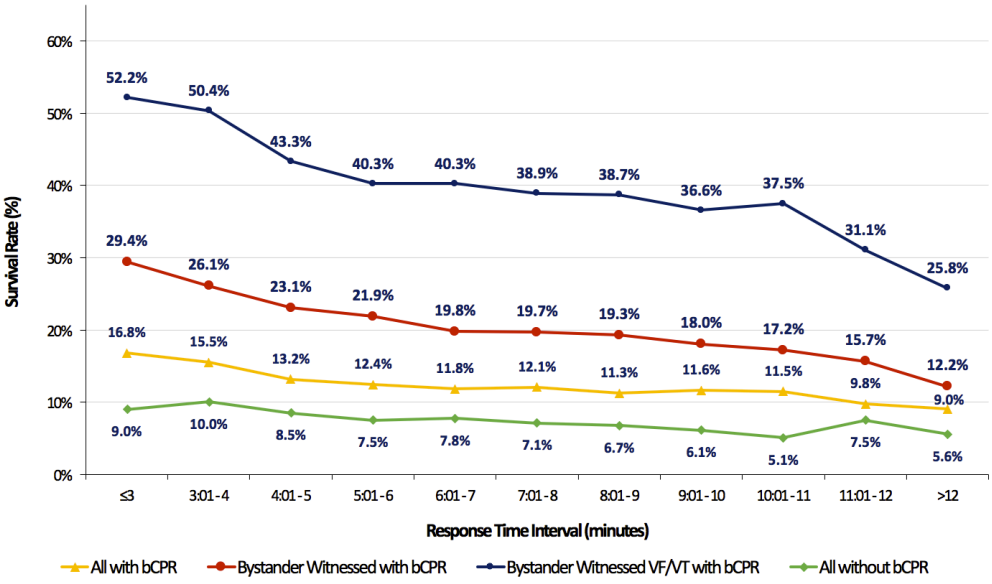


Figure 12. Survival rate by EMS response time and arrest witness status, among patients who received bystander CPR.

A firefighter at Tacoma Fire Communication Center in Washington responds to 911 calls and provides dispatch for Tacoma Fire Department.
Photo courtesy of Tacoma Fire Department; Photo credit: City of Tacoma.

Early CPR

One of the critical interventions to achieving successful resuscitation is early CPR. If CPR is started before an ambulance arrives, the patient's chances of survival dramatically increase. In 2018, bystander CPR was initiated on 39.2% of CARES patients. Of note, CARES excludes 911 Responder witnessed events as well as those that occurred in a nursing home or healthcare facility from our bystander CPR rate, as these are scenarios where we would expect CPR to be performed by a trained medical provider.

Bystander CPR provision was strongly correlated with arrest witness status (Figure 13). Bystander CPR was initiated after 47.4% of bystander witnessed events, compared with 32.8% of unwitnessed events (p<.0001).

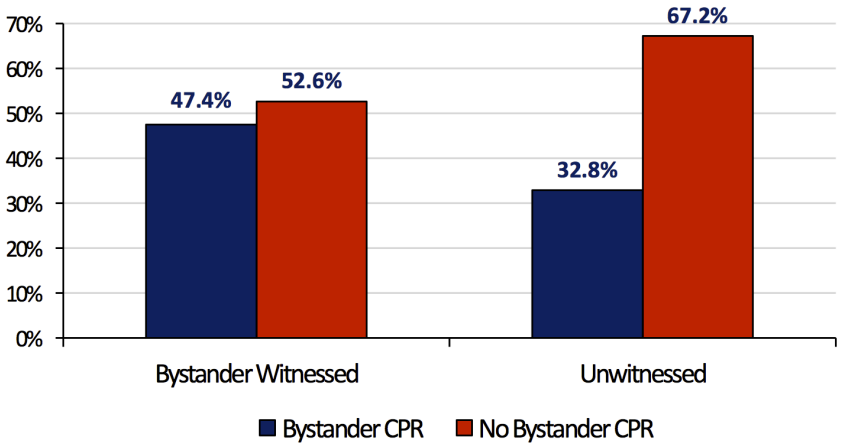


Figure 13. Bystander CPR provision by arrest witness status.

Return of spontaneous circulation (ROSC) in the field, survival to hospital admission, and survival to hospital discharge were all strongly associated with receipt of bystander CPR (Figure 14). The survival to discharge rate for patients receiving bystander CPR (13.6%) was significantly (p<.0001) higher than that of patients who did not receive bystander CPR (7.3%).

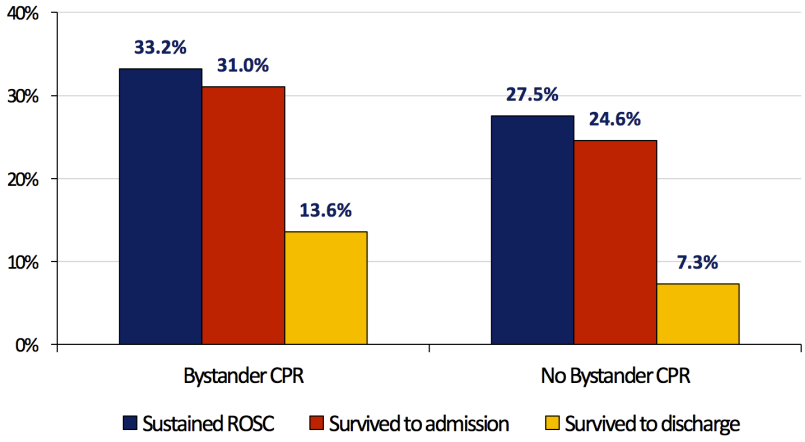


Figure 14. Unadjusted survival outcomes after bystander CPR.

Early Defibrillation

More than 15% of OHCAs occur in a public location; therefore, public access AEDs and community training have a large role to play in early defibrillation. However, the number of patients who have an AED applied by a bystander remains low, occurring after only 11.9% of public arrests.

In 2018, 30.4% (n=24,913) of CARES patients were defibrillated in the field. The proportion of patients first defibrillated by a bystander was 5.7%, whereas 19.5% and 74.8% were first defibrillated by a First Responder or EMS personnel, respectively.

Reducing delays to defibrillation leads to better outcomes for patients in a shockable rhythm. Unadjusted outcomes for this subset of patients vary according to who performed the first defibrillation (Figure 15). The proportion of OHCA patients surviving to hospital discharge when first defibrillated by a bystander with an AED was 47%, compared with 28% of patients first shocked by First Responders or responding EMS personnel.

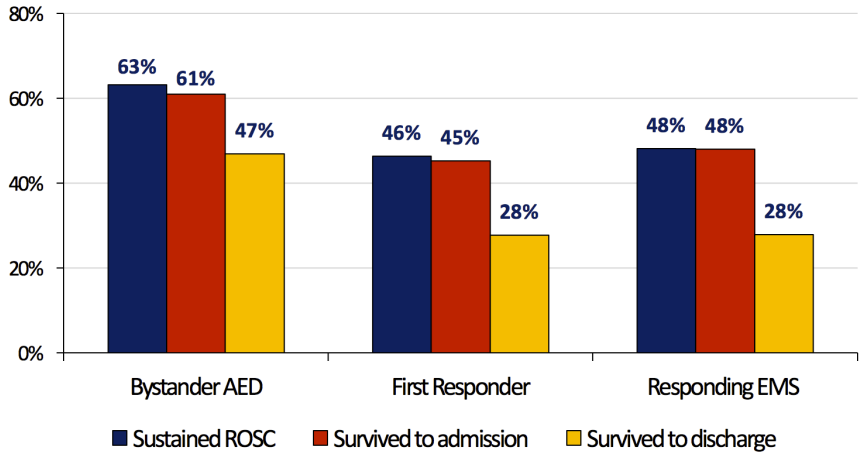


Figure 15. Unadjusted survival outcomes by who performed first defibrillation in the population with a shockable presenting rhythm.

Survival Outcomes

Patient Outcomes

On the basis of local EMS agency protocols, 35.7% of patients were pronounced on scene after resuscitative efforts were terminated in the pre-hospital setting (Figure 16). A successful attempt at resuscitation in the field is often defined by a patient's return of spontaneous circulation (ROSC). In 2018, sustained ROSC (20 consecutive minutes of ROSC, or present at transfer of care to a receiving hospital) was achieved by 31.1% of CARES patients.

The rate of survival to hospital admission was 28.2% (ED outcome missing for 146 cases; 0.2%), and the rate of survival to hospital discharge was 10.4% (hospital outcome missing for 158 cases; 0.2%). A majority of patients who were discharged alive had a neurologically favorable outcome, a Cerebral Performance Category (CPC) score of 1 or 2 (Table 3).

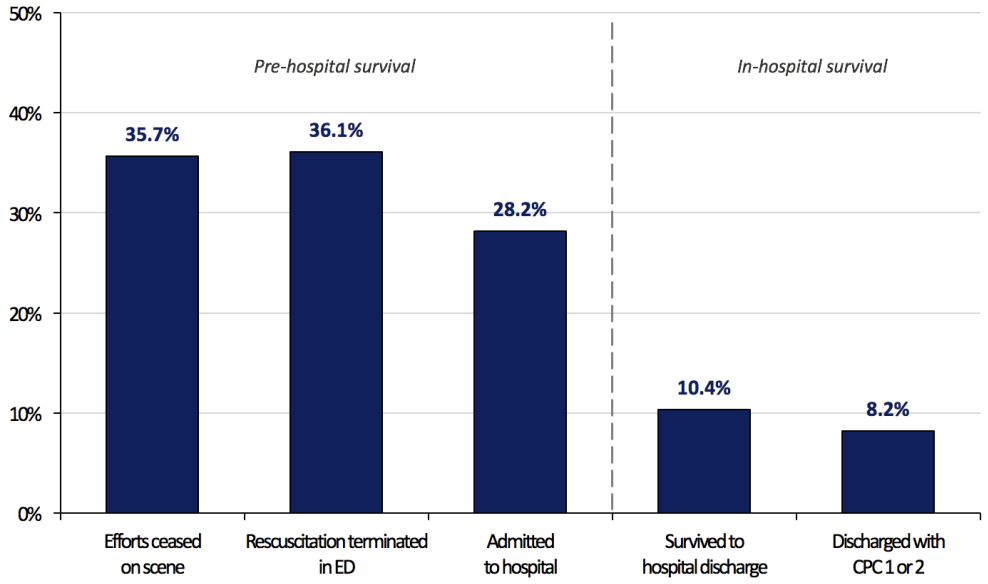


Figure 16. Unadjusted pre-hospital and in-hospital OHCA patient outcomes.

Table 3. Cerebral Performance Category (CPC) scores

CPC Score	Description
CPC 1	Good Cerebral Performance Conscious, alert, able to work and lead a normal life.
CPC 2	Moderate Cerebral Disability Conscious and able to function independently (dress, travel, prepare food), but may have hemiplegia, seizures, or permanent memory or mental changes.
CPC 3	Severe Cerebral Disability Conscious, dependent on others for daily support because of impaired brain function (in an institution or at home with exceptional family effort).
CPC 4	Coma, Vegetative State Not conscious. Unaware of surroundings, no cognition. No verbal or psychological interactions with environment.
CPC 5	Death

Arrest Characteristics and Outcomes

Survival outcomes differed markedly across etiology, presenting rhythm, and witness status categories.

Patients with an arrest of presumed cardiac etiology had an unadjusted survival rate to hospital discharge of 9.8%. Survival among patients with an arrest caused by a respiratory mechanism or drowning was slightly higher (12.8 and 14.1%, respectively), whereas patients with an overdose-related arrest had a survival rate of 15.0%. Survival was lowest among patients with an arrest due to exsanguination or hemorrhage (3.8%) (Figure 17).

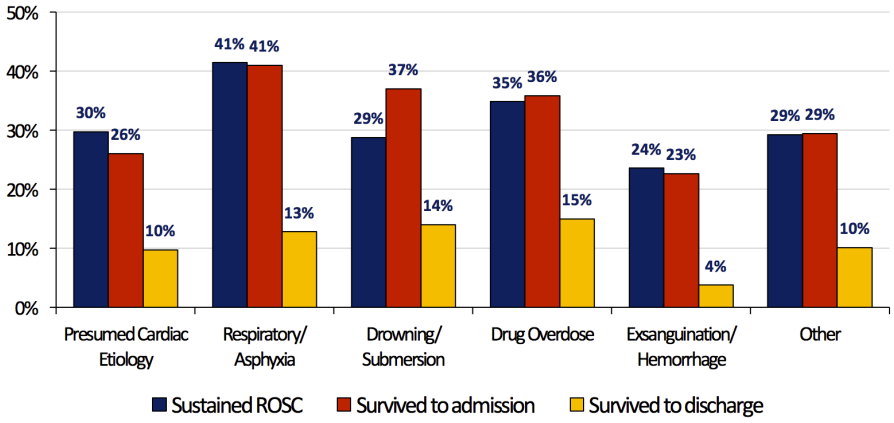


Figure 17. Unadjusted survival outcomes by arrest etiology.

Patients that present with an initial shockable rhythm of ventricular fibrillation (VF) or ventricular tachycardia (VT) have a much higher chance of survival than patients who present with a non-shockable rhythm such as asystole or pulseless electrical activity (PEA) (Figure 18). Patients who presented in a shockable rhythm had a survival to hospital admission rate of 48.2%, compared with 34.6% for those in PEA and 17.0% for those in asystole. Similarly, patients presenting in a shockable rhythm had a greater chance of being discharged alive (29.4%), compared with 9.7% of patients presenting in PEA and 2.4% of patients in asystole.

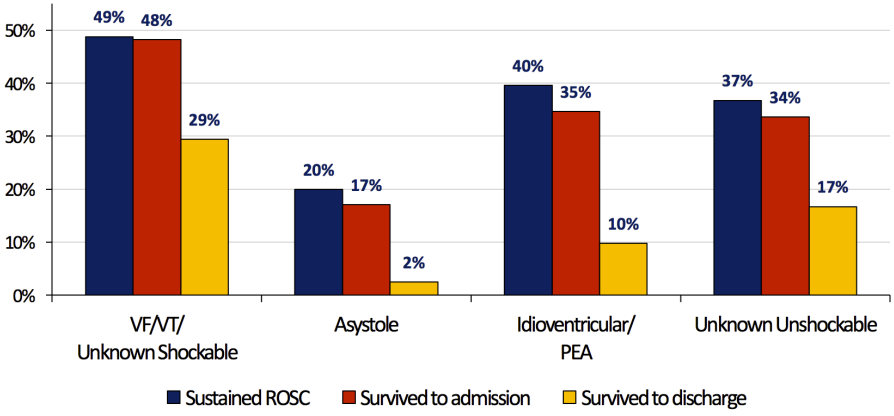


Figure 18. Unadjusted survival outcomes by presenting arrest rhythm.

Arrest witness status also has a significant impact on patient outcomes, as witnessed arrests have more opportunity for bystander intervention and early delivery of care. OHCA patients with a 911 Responder witnessed arrest had the highest chance of survival to hospital discharge (17.9%), followed closely by those with a bystander witnessed arrest (15.8%). In contrast, unwitnessed events had a survival rate of 4.4% (Figure 19).

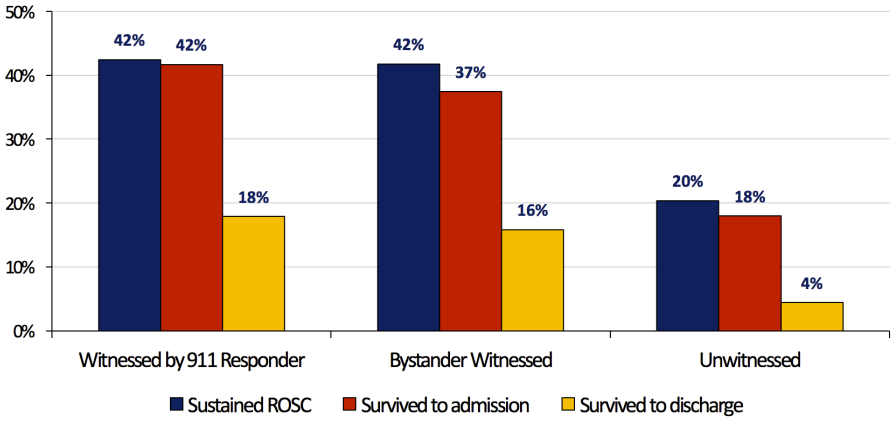


Figure 19. Unadjusted survival outcomes by arrest witness status.

Utstein Survival

The Utstein template was developed by international resuscitation experts to promote uniform reporting guidelines for clinical variables and patient outcomes[2,3]. These guidelines define core data fields to ensure consistency in terminology and make recommendations on the data elements to be recorded for each OHCA event.

Patients who have a bystander witnessed OHCA and present in a shockable rhythm are the most likely to survive their arrest, and are referred to as the "Utstein" subgroup. This subset of arrests is an important measure of system efficacy, allowing for comparison of patient outcomes between systems and time periods, despite the wide variation of cardiac arrest circumstances and patient characteristics.

Figure 20 shows the National CARES Utstein Survival Report for 2018. This report stratifies arrests by witness status and presenting rhythm. In 2018, the survival to hospital discharge rate for the Utstein subgroup was 33.3%. Utstein bystander patients (arrest witnessed by a bystander, presented in a shockable rhythm, and received some bystander intervention [CPR and/or AED application]) had a survival rate of 37.3%.

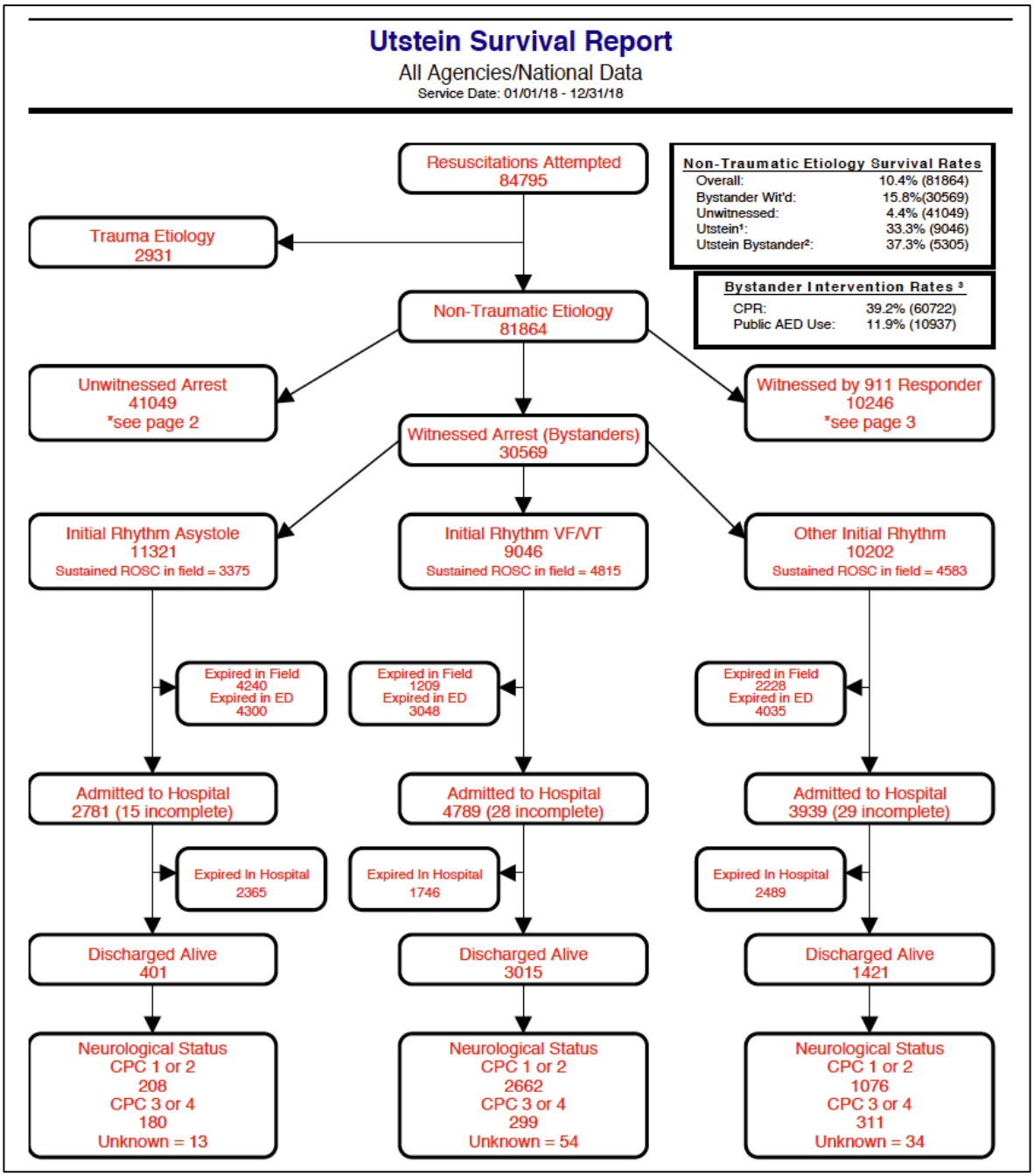


Figure 20. 2018 CARES Non-Traumatic Etiology Utstein Survival Report.

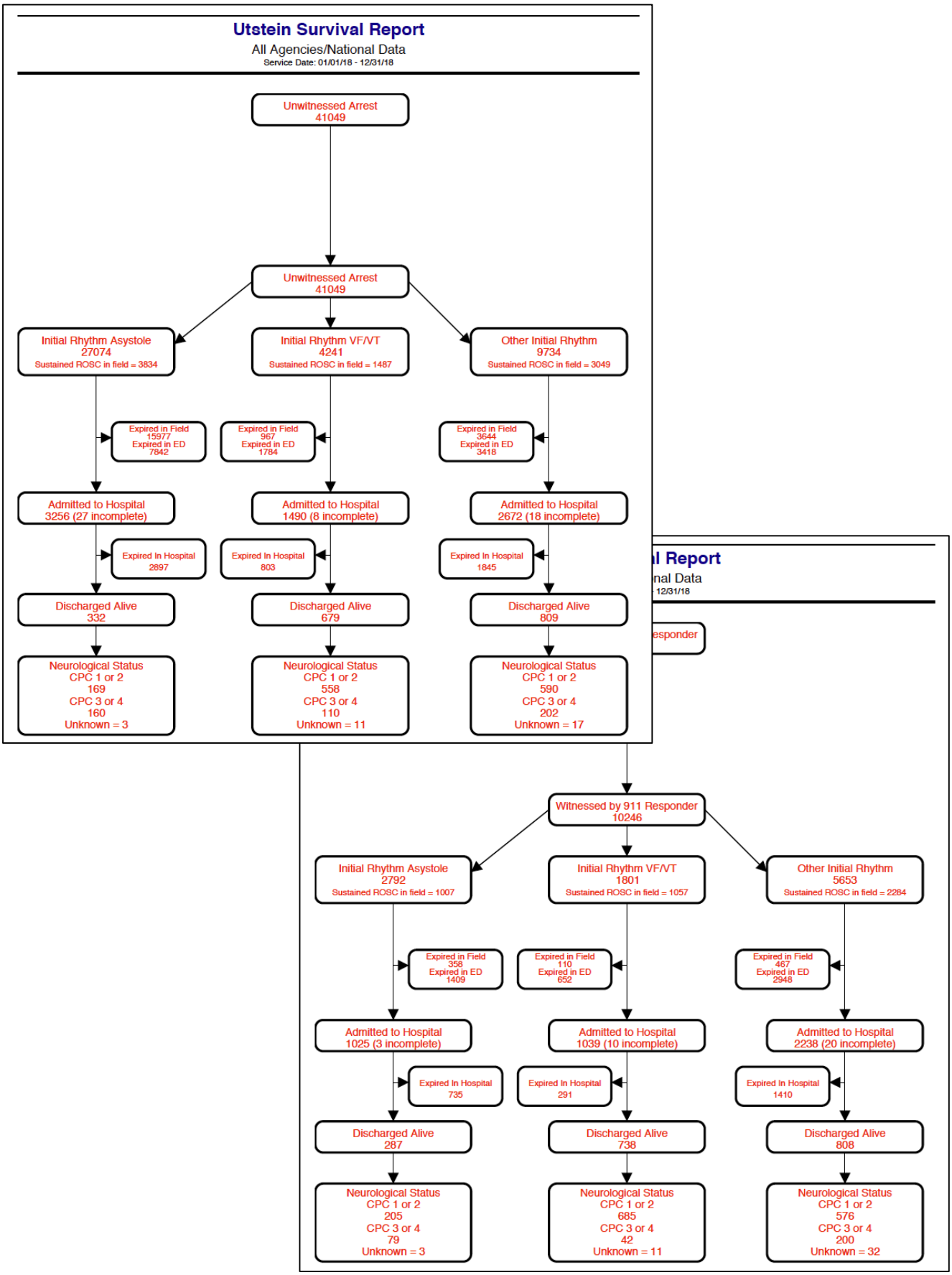


Figure 20. 2018 CARES Non-Traumatic Etiology Utstein Survival Report.

Physicians and medical staff at Weiss Memorial Hospital in Chicago provide compassionate emergency care.
Photo courtesy of Weiss Memorial Hospital.

Hospital Survival

The CARES Hospital Survival Report allows receiving centers to view summary metrics for their patient population. The report follows a flow diagram format, categorizing arrests by sustained ROSC in the field, initial rhythm, and patient outcome, and also allows for filtering of patients by whether they were transported by EMS or transferred from another acute care facility. Figure 21 shows the National CARES Hospital Survival Report for 2018.

Among all patients transported to a hospital, the survival to admission rate was 43.8% and the survival to discharge rate was 16.1%. Survival to hospital discharge was substantially higher among those who achieved sustained ROSC in the field (31.1%) compared with those who did not (2.3%), and among those who were transferred from another facility (46.5%) compared with patients who were transported directly by EMS (14.5%).

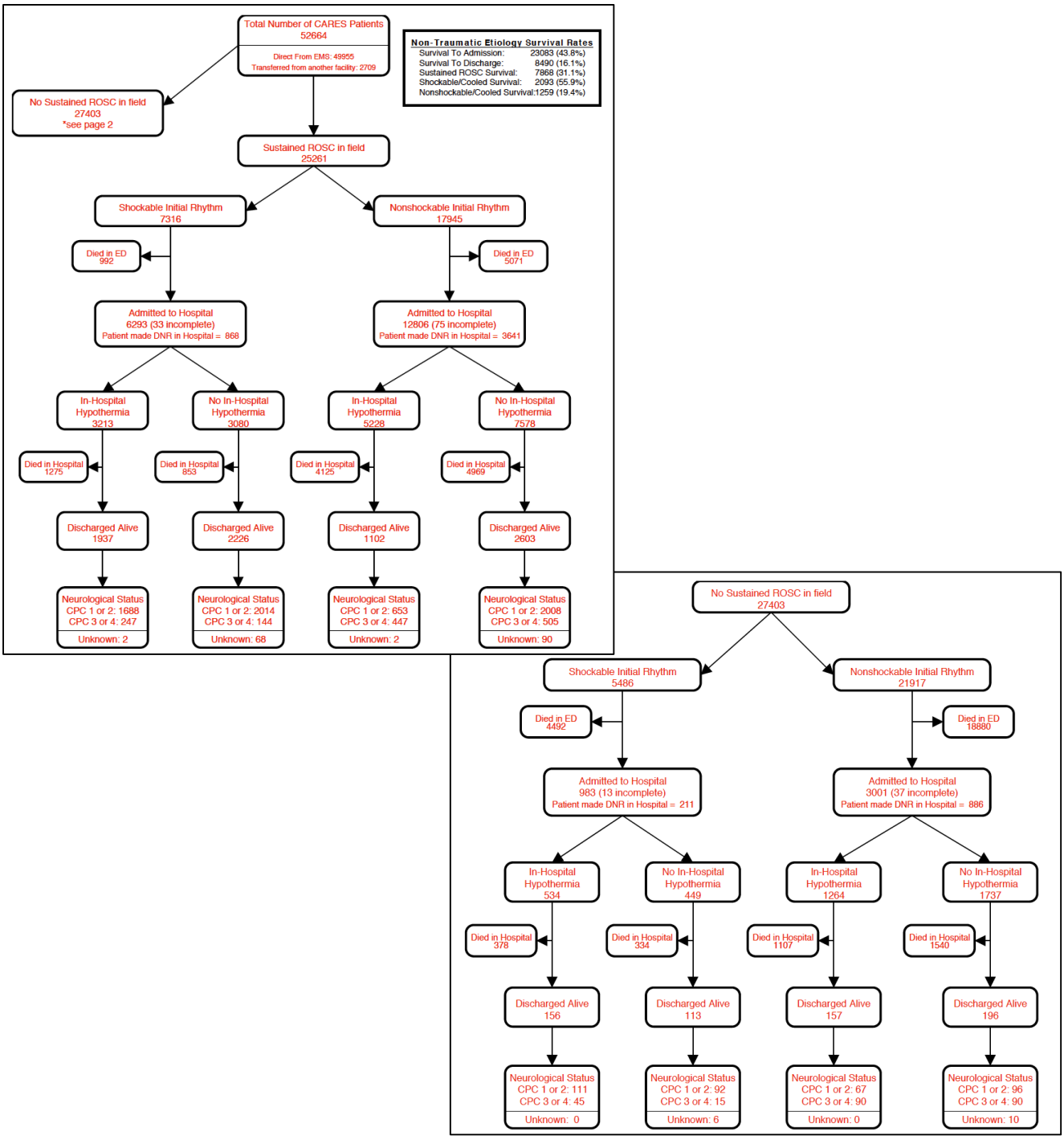


Figure 21. 2018 CARES Non-Traumatic Etiology Hospital Survival Report.

Regional Variation in OHCA Outcomes

There is marked regional variation in OHCA patient outcomes and bystander intervention rates. The diversity of CARES communities allows for comparison of system performance and outcome metrics. The figures below compare overall survival rates (Figure 22), Utstein survival rates (Figure 23), and bystander CPR rates (Figure 24) among the 138 EMS agencies with ≥150 CARES cases in 2018. These figures highlight the significant variability among participating agencies (ranges: overall survival 3.7–20.4% (5-fold difference); Utstein survival 5.6–71.4% (12-fold difference); bystander CPR 11.7–75.3% (6-fold difference). The bars in each figure represent communities with an underlying population ranging from 100,000 to over 2 million. The red dotted line denotes the national average for benchmarking purposes (overall survival: 10.4%; Utstein survival: 33.3%; bystander CPR 39.2%), while the grey vertical lines indicate quartile cutpoints.

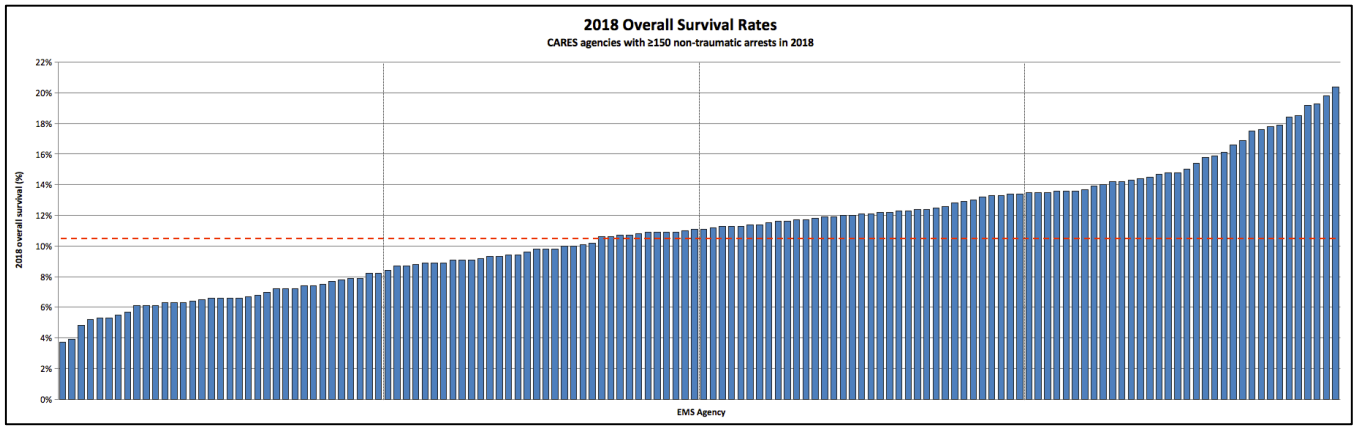


Figure 22. Variability in overall survival rates, among EMS agencies with ≥150 CARES cases in 2018.

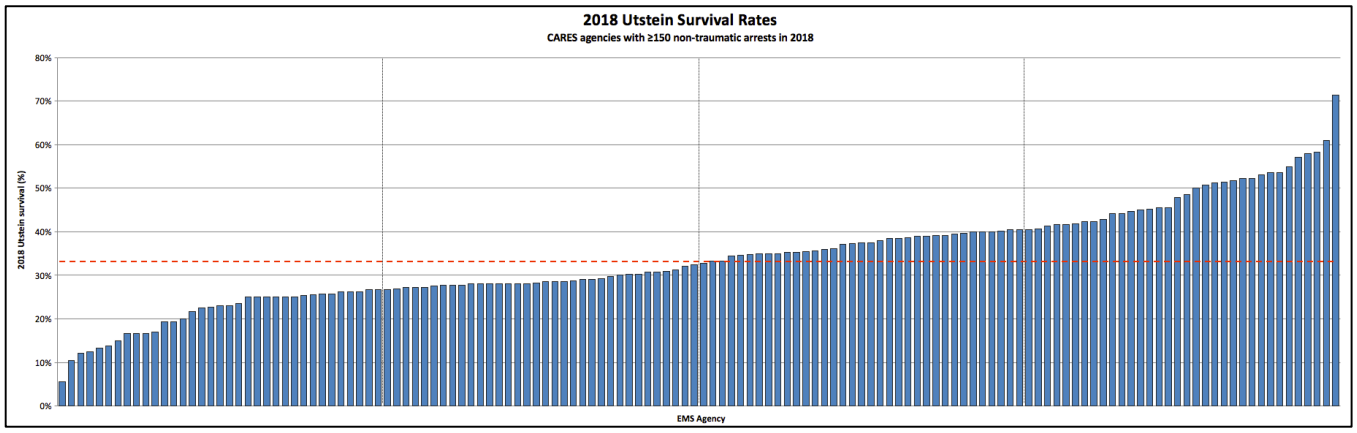


Figure 23. Variability in Utstein survival rates, among EMS agencies with ≥150 CARES cases in 2018.

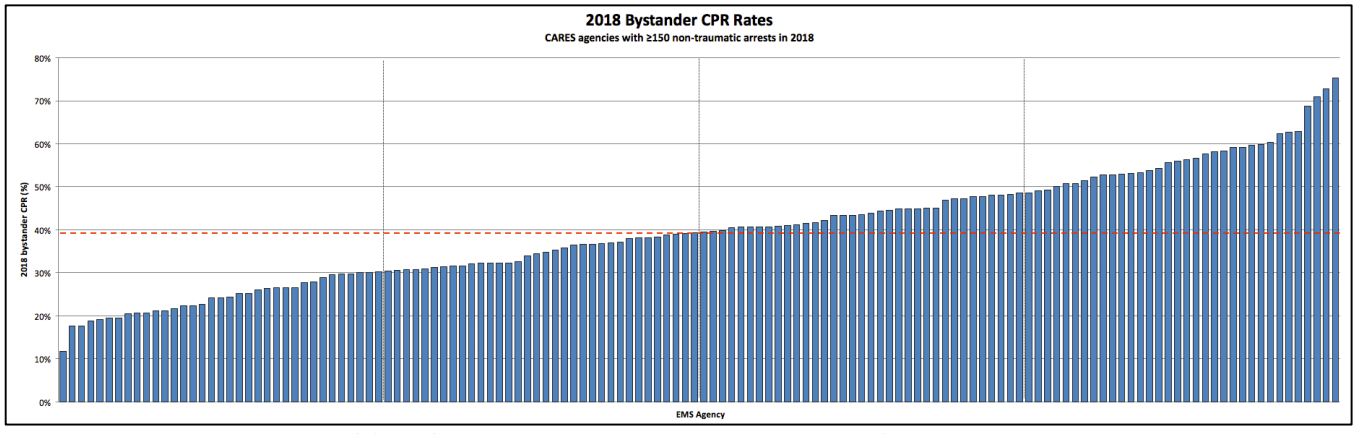


Figure 24. Variability in bystander CPR rates, among EMS agencies with ≥150 CARES cases in 2018.

Healthy People 2020

Every decade, the Healthy People initiative develops a set of objectives to improve the health of all Americans. The topic of "Preparedness" was added to the 2020 objectives, with the goal of strengthening and sustaining communities' abilities to prevent, protect against, mitigate the effects of, respond to, and recover from incidents with negative health effects[6]. Community resilience, the ability of a community to use its assets to strengthen public health and healthcare systems, is a cornerstone of preparedness. CARES is partnering with Healthy People 2020 to focus on and promote bystander response, with the goal of increasing the rates of:

- Bystander CPR for all non-traumatic cardiac arrests.
- Bystander AED use for non-traumatic cardiac arrests occurring in public locations.
- Survival to hospital discharge for patients who receive bystander intervention (through CPR and/or AED application).
- Survival to hospital discharge for Utstein bystander patients (those with a bystander witnessed non-traumatic cardiac arrest that present in a shockable rhythm and receive bystander intervention through CPR and/or AED application).

CARES is utilizing the stable 2015 cohort, comprised of the more than 500 EMS agencies that participated in the registry in 2015 and serve a population of approximately 85 million, to track these metrics longitudinally over a 5-year period (2015 through 2019). The unadjusted 2018 rates for this cohort are listed in Table 4.

Table 4. CARES Healthy People Metrics, 2018

Bystander CPR	40.5%
Bystander AED use in public locations	12.2%
Survival to discharge among patients who received bystander CPR and/or AED application	14.2%
Survival to discharge among Utstein bystander patients	39.0%

2018 Research Highlights

A comprehensive list of CARES publications to-date can be viewed at: https://mycares.net/sitepages/publications.jsp.

Peer-Reviewed Publications

- Andersen LW, Holmberg MJ, Granfeldt A, Løfgren B, Vellano K, McNally BF, Siegerink B, Kurth T, Donnino MW; CARES Surveillance Group. **Neighborhood characteristics, bystander automated external defibrillator use, and patient outcomes in public out-of-hospital cardiac arrest.** *Resuscitation.* 126:72-79.
- El-Assaad I, Al-Kindi SG, McNally B, Vellano K, Worley S, Tang AS, Aziz PF; CARES Surveillance Group. **Automated External Defibrillator Application Before EMS Arrival in Pediatric Cardiac Arrests.** *Pediatrics*. 142(4).
- Masterson S, McNally B, Cullinan J, Vellano K, Escutnaire J, Fitzpatrick D, Perkins GD, Koster RW, Nakajima Y, Pemberton K, Quinn M, Smith K, Jónsson BS, Strömsöe A, Tandan M, Vellinga A. **Out-of-hospital cardiac arrest survival in international airports.** *Resuscitation*. 127:58-62.
- Coute RA, Shields TA, Cranford JA, Ansari S, Abir M, Tiba MH, Dunne R, O'Neil B, Swor R, Neumar RW; SaveMiHeart Consortium and the CARES Surveillance Group. **Intrastate Variation in Treatment and Outcomes of Out-of-Hospital Cardiac Arrest.** *Prehospital Emergency Care*. 22(6):743-752.
- May S, Zhang L, Foley D, Brennan E, O'Neil B, Bork E, Levy P, Dunne R. **Improvement in Non-Traumatic, Out-Of-Hospital Cardiac Arrest Survival in Detroit From 2014 to 2016.** *Journal of the American Heart Association*. 7(16).
- Malta Hansen C, Kragholm K, Dupre ME, Pearson DA, Tyson C, Monk L, Rea TD, Starks MA, Nelson D, Jollis JG, McNally B, Corbett CM, Granger CB. **Association of Bystander and First-Responder Efforts and Outcomes According to Sex: Results From the North Carolina HeartRescue Statewide Quality Improvement Initiative.** *Journal of the American Heart Association*. 7(18).
- Bradley SM, Liu W, McNally B, Vellano K, Henry TD, Mooney MR, Burke MN, Brilakis ES, Grunwald GK, Adhaduk M, Donnino M, Girotra S, for the CARES Surveillance Group. **Temporal Trends in the Use of Therapeutic Hypothermia for Out-of-Hospital Cardiac Arrest.** *JAMA Network Open*. 2018;1(7):e184511.
- Kearney KE, Maynard C, Smith B, Rea TD, Beatty A, McCabe JM. **Performance of coronary angiography and intervention after out of hospital cardiac arrest.** *Resuscitation*. 133:141-146.
- Hansen SM, Hansen CM, Fordyce CB, Dupre ME, Monk L, Tyson C, Torp-Pedersen C, McNally B, Vellano K, Jollis J, Granger CB; CARES Surveillance Group. **Association Between Driving Distance From Nearest Fire Station and Survival of Out-of-Hospital Cardiac Arrest.** *Journal of the American Heart Association*. 7(21).

Abstracts

- Summers J, Berry C, Knorr A, Olaf M, Kupas D. **EMS Agencies with High Rates of Field Termination of Cardiac Arrest Care Also Have High Rates of Survival**. National Association of EMS Physicians Annual Meeting; 2018 January 11-13; San Diego, CA.
- Amen A, Karabon P, McNally B, Bartram C, Irwin K, Vellano K, Swor R. **Are There Disparities in Dispatch CPR Instruction Receipt and CPR Performance?** National Association of EMS Physicians Annual Meeting; 2018 January 11-13; San Diego, CA.
- Pun PH, Dupre M, Anderson M, Hansen SM, Tyson C, Frizzelle B, Vellano K, Jollis J, McNally B, Granger C. **Characteristics of Cardiac Arrest and Bystander Resuscitation Within Outpatient Dialysis Clinics in North Carolina**. American College of Cardiology 67th Annual Scientific Session; 2018 March 10-12; Orlando, FL.

- Coute RA, Nathanson BH, Panchal A, Kurz M, Haas NL, Mader T. **Disability-Adjusted Life Years Following Out-of-Hospital Cardiac Arrest in the United States**. Society for Academic Emergency Medicine Annual Meeting; 2018 May 14-16; Indianapolis, IN.
- Burla M, Amen A, Otero R, Swor R. **Do We Really Know Who Receives Bystander Cardiopulmonary Resuscitation Prior to Emergency Medical Services Arrival?** Society for Academic Emergency Medicine Annual Meeting; 2018 May 14-16; Indianapolis, IN.
- Del Rios M, Weber J, Campbell T, Nyguen H, Pugach O, Markul E, Gerber B, Sharp L, Vanden Hoek T. **Dispatch-Assisted Cardiopulmonary Resuscitation Coupled with Bystander Cardiopulmonary Resuscitation Training in Priority Neighborhoods Improves Cardiac Arrest Survival**. Society for Academic Emergency Medicine Annual Meeting; 2018 May 14-16; Indianapolis, IN.
- Bradley SM, Liu W, McNally M, Vellano K, Henry T, Mooney MR, Burke N, Brilakis ES, Grunwald GK, Adhaduk M, Donnino M, Girotra S. **Temporal Trends in the Use of Therapeutic Hypothermia for Out-of-Hospital Cardiac Arrest: Insights from the CARES Registry**. AHA Quality of Care and Outcomes Research Scientific Sessions; 2018 April 6-7; Arlington, VA.
- Vetter VL, Dalldorf KF, Rossano J, Naim MY, Glatz AC, Vellano K, McNally B, Griffis H. **When Laws Save Lives: Impact of Legislation Requiring Cardiopulmonary Resuscitation Education in High Schools on Survival After Sudden Cardiac Arrest**. American Heart Association Resuscitation Science Symposium; 2018 November 10-11; Chicago, IL.
- Griffis H, Wu L, Naim M, Tobin J, McNally B, Vellano K, Quan L, Markenson D, Bradley R, Rossano J. **The Influence of Age, Race, and Ethnicity on Public Automated External Defibrillator Use and Outcomes of Pediatric Out-of-Hospital Cardiac Arrest in the United States: An Analysis of the Cardiac Arrest Registry to Enhance Survival (CARES).** American Heart Association Resuscitation Science Symposium; 2018 November 10-11; Chicago, IL.
- Abir M, Salhi R, Goldstick J, Lehrich J, Fouche S, Setodji C, Forbush B, Kronick S, Shields T, Brennan E, Swor R, O'Neil B, Neumar R, Nallamothu B. **Evaluating Variation in Return of Spontaneous Circulation Rates Across EMS Agencies in Michigan**. American Heart Association Resuscitation Science Symposium; 2018 November 10-11; Chicago, IL.
- Coute RA, Nathanson B, Panchal A, Kurz M, Haas N, McNally B, Neumar R, Mader T. **Estimating the Impact of Bystander Interventions on Disability-Adjusted Life Years Following Adult Out-of-Hospital Cardiac Arrest in the United States**. American Heart Association Resuscitation Science Symposium; 2018 November 10-11; Chicago, IL.
- Naim MY, Griffis H, Berg RA, Bradley RN, Hansen ML, Markenson D, McNally BF, Nadkarni VM, Vellano K, Rossano JW. **The Epidemiology of Airway Management Following Pediatric Out-of-Hospital Cardiac Arrest in the United States**. American Heart Association Resuscitation Science Symposium; 2018 November 10-11; Chicago, IL.
- Chen J, Effoe V, Lisko J, Sabbak N, Reginauld S, Ko Y, Corrigan F, Lerakis S. **Higher Walk Score Associated with Higher Rates of Bystander AED Use in Street-Level Cardiac Arrest**. American Heart Association Resuscitation Science Symposium; 2018 November 10-11; Chicago, IL.
- Naim MY, Griffis H, Berg RA, Bradley RN, Burke RV, Markenson D, McNally BF, Nadkarni VM, Song L, Vellano K, Rossano JW. **Conventional Bystander CPR is Associated with Higher Neurologically Favorable Survival in Children Compared to Compression Only CPR Following Pediatric Out of Hospital Cardiac Arrest.** American Heart Association Scientific Sessions; 2018 November 10-12; Chicago, IL.
- Naim MY, Griffis H, Berg RA, Bradley RN, Hansen ML, Markenson D, McNally BF, Nadkarni VM, Vellano K, Rossano JW. **Comparison of Tracheal Intubation vs. Supraglottic Airway Following Pediatric Out of Hospital Cardiac Arrest**. American Heart Association Scientific Sessions; 2018 November 10-12; Chicago, IL.

List of Abbreviations & Definitions

AED	Automated External Defibrillator
CARES	Cardiac Arrest Registry to Enhance Survival
CPC	Cerebral Performance Category
CPR	Cardiopulmonary Resuscitation
DNR	Do Not Resuscitate
ED	Emergency Department
EMS	Emergency Medical Services
OHCA	Out-Of-Hospital Cardiac Arrest
PEA	Pulseless Electrical Activity
ROSC	Return of Spontaneous Circulation
SIDS/SUID	Sudden infant death syndrome/Sudden unexpected infant death
VF	Ventricular Fibrillation
VT	Ventricular Tachycardia

References

1. Graham R, McCoy MA, Schultz AM. Strategies to improve cardiac arrest survival: A Time to Act. Institute of Medicine. 2015.

2. Cummins RO, Chamberlain DA, Abramson NS, Allen M, Baskett PJ, Becker L, Bossaert L, Delooz HH, Dick WF, Eisenberg MS, Evans TR, Holmberg S, Kerber R, Mullie A, Ornato JP, Sandoe E, Skulberg A, Tunstall-Pedoe H, Swanson R, Thies WH. Recommended guidelines for uniform reporting of data from out-of-hospital cardiac arrest: The Utstein style. A statement for health professionals from a Task Force of the American Heart Association, the European Resuscitation Council, the Heart and Stroke Foundation of Canada, and the Australian Resuscitation Council. Circulation. 1991; 84:960-975.

3. Perkins GD, Jacobs IG, Nadkarni VM, Berg RA, Bhanji F, Biarent D, Bossaert LL 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. Resuscitation. 2015; 96:328-340.

4. Annual Estimates of the Resident Population: April 1, 2010 to July 1, 2018 Source: U.S. Census Bureau, Population Division

5. Larsen MP, Eisenberg MS, Cummins RO, Hallstrom AP. Predicting survival from out-of-hospital cardiac arrest: a graphic model. Ann Emerg Med. 1993; 22:1652–1658.

6. Office of Disease Prevention and Health Promotion. Healthy People 2020 Topics and Objectives: Preparedness. Retrieved from https://www.healthypeople.gov/2020/topics-objectives/topic/preparedness.

MetroAtlanta Ambulance Service transports an out-of-hospital cardiac arrest patient to WellStar Kennestone Hospital in Marietta, Georgia.
Photo courtesy of MetroAtlanta Ambulance Service, Cobb County.

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