About This Report

This report is the product of the Enhancing Prehospital Outcomes for Cardiac Arrest (EPOC) study and provides strategies to improve cardiac arrest outcomes. The report is expected to be of interest to frontline providers, medical directors, policymakers, and community advocates invested in improving cardiac arrest outcomes.

This research was funded (grant number 5R01HL137964-04) by the National Institutes of Health (NIH) National Heart, Lung, and Blood Institute (NHLBI) and was carried out as a collaboration among researchers from the University of Michigan, within the Quality Measurement and Improvement Program in RAND Health Care, and SaveMiHeart.

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We extend our deepest gratitude to Paul Koegel, Jeanne Ringel, Carrie Farmer, and Tom Bouthillet for their careful review of this report. Their feedback and comments helped improve this work.

We dedicate this report to first-responders who work to save lives every day in communities across the United States.
Summary

Out-of-hospital cardiac arrest (OHCA) is a common, life-threatening event that is a leading cause of death in the United States. Of the approximately 305,800 cases of OHCA treated by emergency medical services (EMS) in 2021, about 91 percent result in death (Cardiac Arrest Registry to Enhance Survival [CARES], 2021). An estimated 24 percent of patients survive to hospital admission, and 9 percent are discharged alive (CARES, 2021). A 2015 National Academy of Medicine report highlighted substantial regional variations in successful OHCA response and treatment across the United States—specifically, survival rates between communities (Graham, McCoy, and Schultz, 2015).

To improve patient outcomes, it is imperative to understand how EMS agencies treat OHCA in routine clinical practice. The American Heart Association (AHA) recognizes the chain of survival as an operational framework for assessing EMS response to OHCA. This framework consists of six interdependent links:

- recognition of cardiac arrest and activation of emergency response
- early cardiopulmonary resuscitation (CPR)
- rapid defibrillation
- effective advanced cardiac life support (ACLS)
- integrated post-resuscitative care
- recovery (Merchant et al., 2020).

Each link in the chain of survival must be considered when evaluating opportunities for improving EMS care quality for OHCA. When these links are implemented, victims have improved chances of survival. For example, among nontraumatic cardiac arrests witnessed by bystanders and found in a shockable rhythm in 2021, survival was actually 29 percent (CARES, 2021).

However, it is unclear how to design strategies that best address these links and can be successfully implemented in EMS agencies and broader emergency response systems (such as fire, police, dispatch, and bystanders to OHCA events) in different communities to help improve daily care processes and outcomes in OHCA. Accordingly, the National Heart, Lung, and Blood Institute (NHLBI)–funded Enhancing Pre-Hospital Outcomes for Cardiac Arrest (EPOC) study lays the foundation for future quality improvement efforts in OHCA by identifying, understanding, and validating the strategies adopted within emergency response systems to address these life-threatening events and by addressing potential barriers to implementation of these practices. These approaches, taken together, form the EPOC strategies described in the report.
Focus of the Report

The findings from the EPOC study were analyzed to produce strategies to improve OHCA survival and care delivery in communities across the United States. The two aims of the EPOC study leading to the strategies were:

- **Aim 1.** Identify variations in OHCA survival among EMS agencies and communities.
- **Aim 2.** Define system-of-care best practices for OHCA survival.

The study focused on prehospital care in Michigan, particularly those EMS agencies that participated in the Michigan Cardiac Arrest Registry to Enhance Survival (MI-CARES) (Abir, Fouche, et al., 2021). We focused on care in the prehospital setting because this area of care has been shown to vary strongly across communities, and little is known about the impact of different processes of care for OHCA despite its importance.

Methods

This study used a mixed-methods approach. First, a quantitative analysis was performed to stratify high-, intermediate-, and low-performing emergency response systems. Second, we conducted in-depth, semistructured key informant interviews and multidisciplinary focus groups with more than 160 personnel from 911/dispatch, EMS, non-transport fire, and police in nine emergency response systems with high-, intermediate-, and low-survival outcomes to produce and validate our findings. Information from these site visits was then compiled and analyzed using qualitative analysis. Strategies identified from the qualitative analysis were extracted by two researchers into templates organized by different categories relating to the OHCA system of care to inform our strategies. Third, we conducted a literature review of peer-reviewed publications to determine how our findings might be enhanced and refined by the current academic knowledge on the varied issues across the system of care for OHCA. Approaches were deemed applicable for our strategies according to the level of supporting evidence from all of the qualitative and literature review data.

One of the approaches we used to identify best practices was to compare the high-performing emergency medical systems that we visited with the low-performing ones. We started with site visits to high-performing sites and to low-performing sites. Upon completing these site visits, we looked across the interview and focus group transcripts to see what high-performing systems did (and, conversely, low-performing systems did not do). These comparisons helped identify promising OHCA response strategies, especially those that were noted as important for success in high-performing sites and were absent in low-performing sites. Promising practices were also identified in low-performing sites, particularly where they address important barriers to high performance, and some informed the recommended strategies in this report. The two intermediate performing systems were in rural areas with some creative solutions to OHCA response in the setting of poor resources.
Results and Strategies

Findings from the analysis revealed strategies to improve OHCA survival and potential practices to improve care delivery from a system-of-care perspective. We developed a total of 49 strategies covering all levels of the prehospital OHCA incident response and the principles of change management necessary to implement the strategies. These are listed in Table S.1. These strategies cover the incident, stakeholder, and system levels. Strategies to improve OHCA outcomes can be adopted by individual stakeholders but are also applicable across the system of care.

Table S.1. EPOC Study Report Strategies

<table>
<thead>
<tr>
<th>No.</th>
<th>Category</th>
<th>Strategy</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Activation phase</td>
<td>Use modern location identification technology to find the emergency.</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>Leverage tools to improve recognition of cardiac arrest for public and frontline providers.</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>For dispatch centers, conference rather than transfer callers.</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>Send responders from different disciplines to reduce response times.</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>Dispatch the closest qualified units regardless of jurisdiction.</td>
</tr>
<tr>
<td>6</td>
<td></td>
<td>Advocate payment models that eliminate or reduce charge on patients for high acuity emergencies.</td>
</tr>
<tr>
<td>7</td>
<td>Pre-arrival phase</td>
<td>Provide 911 callers with pre-arrival instructions for scene preparation and CPR/ automated electronic defibrillator (AED) use.</td>
</tr>
<tr>
<td>8</td>
<td></td>
<td>Develop processes for dispatch to use in providing updates to responding units as additional information from the scene becomes available.</td>
</tr>
<tr>
<td>9</td>
<td></td>
<td>Foster the practice of game planning while responding to the scene.</td>
</tr>
<tr>
<td>10</td>
<td>On-scene phase</td>
<td>Provide high-quality CPR throughout the incident.</td>
</tr>
<tr>
<td>11</td>
<td></td>
<td>Foster effective on-scene communication and a culture of constructive feedback.</td>
</tr>
<tr>
<td>12</td>
<td></td>
<td>Adapt the scene or patient positioning to facilitate care.</td>
</tr>
<tr>
<td>13</td>
<td></td>
<td>Use modern clinical equipment effectively and appropriately.</td>
</tr>
<tr>
<td>14</td>
<td>Early professional response sub-phase</td>
<td>Encourage aggressive CPR and AED intervention by the first emergency personnel on the scene, including police and non-transport fire.</td>
</tr>
<tr>
<td>15</td>
<td></td>
<td>For early responders, keep dispatch updated on patient condition and resource needs.</td>
</tr>
<tr>
<td>16</td>
<td>Full resuscitation team sub-phase</td>
<td>Appoint one responder to manage the logistics of the scene.</td>
</tr>
<tr>
<td>17</td>
<td></td>
<td>Track the resuscitation team’s work in real time using a formal checklist.</td>
</tr>
<tr>
<td>18</td>
<td></td>
<td>Deploy a sufficient number of qualified personnel to fill necessary roles on scene.</td>
</tr>
<tr>
<td>19</td>
<td></td>
<td>Send more than one advanced provider to the incident.</td>
</tr>
<tr>
<td>20</td>
<td></td>
<td>Crews stay on scene and do the work.</td>
</tr>
<tr>
<td>No.</td>
<td>Category</td>
<td>Strategy</td>
</tr>
<tr>
<td>-----</td>
<td>---------------------------------------</td>
<td>-------------------------------------------------------------------------</td>
</tr>
<tr>
<td>21</td>
<td>Transport phase</td>
<td>Leverage other first responders to drive the ambulance so multiple EMS personnel can work together in the patient compartment.</td>
</tr>
<tr>
<td>22</td>
<td>Transport phase</td>
<td>Transport OHCA patients with advanced life support (ALS) units or arrange to meet an ALS unit on the way to the hospital.</td>
</tr>
<tr>
<td>23</td>
<td>Transport phase</td>
<td>Consider use of ventilators and mechanical CPR devices to offset limitations of care while in-transport.</td>
</tr>
<tr>
<td>24</td>
<td>Transport phase</td>
<td>Communicate patient information to the receiving hospital in a meaningful way.</td>
</tr>
<tr>
<td>25</td>
<td>Emergency department handoff phase</td>
<td>Provide structured handoffs in an efficient, standardized manner.</td>
</tr>
<tr>
<td>26</td>
<td>Emergency department handoff phase</td>
<td>Facilitate active engagement of all participants in the handoff.</td>
</tr>
<tr>
<td>27</td>
<td>Debriefing phase</td>
<td>Conduct a debriefing after a cardiac arrest event.</td>
</tr>
<tr>
<td>28</td>
<td>Debriefing phase</td>
<td>Collect and share information from various sources (i.e., AED recordings, body camera recordings, documentation) and generate reports on all cardiac arrest incidents for quality improvement purposes.</td>
</tr>
</tbody>
</table>

**Stakeholder level**

<table>
<thead>
<tr>
<th>No.</th>
<th>Community factors</th>
<th>Strategy</th>
</tr>
</thead>
<tbody>
<tr>
<td>29</td>
<td>Community factors</td>
<td>Implement community education programs on cardiac arrest recognition, performing CPR, and AED application.</td>
</tr>
<tr>
<td>30</td>
<td>Community factors</td>
<td>Invest in public access AED programs.</td>
</tr>
<tr>
<td>31</td>
<td>Emergency responder training</td>
<td>Create a standardized training program for each stakeholder tailored to their specific roles.</td>
</tr>
<tr>
<td>32</td>
<td>Emergency responder training</td>
<td>Ensure that recurrent training occurs on OHCA topics.</td>
</tr>
<tr>
<td>33</td>
<td>Emergency responder training</td>
<td>Promote cross-training responders in multiple roles.</td>
</tr>
<tr>
<td>34</td>
<td>Material resources</td>
<td>Invest in robust grant writing resources.</td>
</tr>
<tr>
<td>35</td>
<td>Public safety agency culture</td>
<td>Encourage agency leaders to enhance the resuscitation culture of their agencies.</td>
</tr>
<tr>
<td>36</td>
<td>Public safety agency quality improvement</td>
<td>Develop a structured quality improvement program for cardiac arrest.</td>
</tr>
</tbody>
</table>

**System level**

<table>
<thead>
<tr>
<th>No.</th>
<th>Cultivating community-institution relationships</th>
<th>Strategy</th>
</tr>
</thead>
<tbody>
<tr>
<td>37</td>
<td>Cultivating community-institution relationships</td>
<td>Engage with community organizations.</td>
</tr>
<tr>
<td>38</td>
<td>Cultivating institutional relationships</td>
<td>Establish a culture of open communication among institutional stakeholders.</td>
</tr>
<tr>
<td>39</td>
<td>Cultivating institutional relationships</td>
<td>Maximize the frequency of crew interactions in both emergency and non-emergency settings.</td>
</tr>
<tr>
<td>40</td>
<td>Interdisciplinary training</td>
<td>Implement collaborative training opportunities across stakeholders.</td>
</tr>
<tr>
<td>41</td>
<td>Collective resource management</td>
<td>Consolidate high-cost resources as a mechanism to provide optimal care for the community.</td>
</tr>
<tr>
<td>No.</td>
<td>Category</td>
<td>Strategy</td>
</tr>
<tr>
<td>-----</td>
<td>-----------------------------------</td>
<td>--------------------------------------------------------------------------</td>
</tr>
<tr>
<td>42</td>
<td>Regionalization/standardization</td>
<td>Establish a standardized care protocol for all stakeholders.</td>
</tr>
<tr>
<td>43</td>
<td></td>
<td>Ensure compatibility of the equipment used across responder groups.</td>
</tr>
<tr>
<td>44</td>
<td>Interdisciplinary quality improvement</td>
<td>Provide feedback on OHCA performance and outcomes to all responder groups.</td>
</tr>
<tr>
<td>45</td>
<td></td>
<td>Share data in aggregate and review performance jointly.</td>
</tr>
<tr>
<td></td>
<td>Change management</td>
<td></td>
</tr>
<tr>
<td>46</td>
<td>Change management</td>
<td>Understand the red tape, financial barriers, and incentives that stakeholders must navigate.</td>
</tr>
<tr>
<td>47</td>
<td></td>
<td>Involve all stakeholders in changes.</td>
</tr>
<tr>
<td>48</td>
<td></td>
<td>Implement change in phases.</td>
</tr>
<tr>
<td>49</td>
<td></td>
<td>Run a trial period and gather feedback on new equipment, policy, etc., before widely disseminating changes.</td>
</tr>
</tbody>
</table>
Contents

About This Report .................................................................................................................................. iii
Summary ............................................................................................................................................... iv
Figures and Tables ............................................................................................................................... xi
Chapter 1. Background and Objectives ............................................................................................. 1
  Wide Variation in Response Times and Outcomes ............................................................................ 1
  The EPOC Study and Report: Understanding Implementation of Strategies and System Improvement in Diverse Communities .............................................................. 3
  Organization of the Report ................................................................................................................. 4
Chapter 2. Chain of Survival and Emergency Response Systems ..................................................... 6
  The Diversity of Emergency Response Systems .............................................................................. 7
  The OHCA Response ‘Machine’ .......................................................................................................... 9
  Activation Phase ................................................................................................................................. 13
  Pre-Arrival Phase ............................................................................................................................... 19
  On-Scene Phase ................................................................................................................................. 23
  Early Professional Response Sub-Phase ............................................................................................. 31
  Full Resuscitation Team Sub-Phase ................................................................................................. 33
  Transport Phase ................................................................................................................................. 41
  Handoff Phase .................................................................................................................................. 45
  Debriefing Phase ............................................................................................................................... 48
  Incident-Level Conclusions .............................................................................................................. 51
Chapter 4. Part 2: Stakeholder-Level—Optimizing Each System Component ................................. 52
  Introduction ....................................................................................................................................... 52
  Community Factors ......................................................................................................................... 52
  Public Safety Factors ....................................................................................................................... 57
  Material Resources ........................................................................................................................... 64
  Organizational Culture ...................................................................................................................... 66
  Public Safety Quality Assurance ...................................................................................................... 70
Chapter 5. Part 3: System Level—Assembling and Maintaining the OHCA Response Machine ......... 72
  Cultivating Community-Institution Relationships ......................................................................... 72
  Cultivating Institutional Relationships ............................................................................................. 75
  Interdisciplinary Training .................................................................................................................. 78
  Collective Resource Management .................................................................................................... 81
  Regionalization/Standardization ....................................................................................................... 82
  Interdisciplinary Quality Improvement ............................................................................................. 85
  System-Level Conclusions .............................................................................................................. 87
Figures and Tables

Figures

Figure 2.1. Key Steps in OHCA Care: The AHA Out-of-Hospital Chain of Survival ...............6
Figure 2.2. The Emergency Response Phases and Stakeholders Involved ..............................7
Figure 2.3. Agency-Level and Incident-Level Factors ..........................................................8
Figure 3.1. Incident-Level Factors Components of Care .......................................................12
Figure 3.2. Activation Phase .........................................................................................14
Figure 3.3. Pre-Arrival Phase ......................................................................................20
Figure 3.4. On-Scene Phase .........................................................................................24
Figure 3.5. Early Professional Response Sub-Phase .........................................................31
Figure 3.6. Full Resuscitation Team Sub-Phase .................................................................33
Figure 3.7. Transport Phase ..........................................................................................41
Figure 3.8. Handoff Phase ............................................................................................45
Figure 3.9. Quality Improvement Processes at Every Level ..............................................48

Tables

Table S.1. EPOC Study Report Strategies ........................................................................vi
Table 1.1. Practices and Processes Contributing to a Successful OHCA Response and Survival Rate ..................................................................................................................2
Table 1.2. Characteristics of High-, Intermediate-, and Lower-Performing Sites in the EPOC Study ..........................................................................................................................3
Table 3.1. Common Resuscitation Devices and Their Uses .................................................29
Table 3.2. Full-Resuscitation Team Roles/Responsibilities .................................................37
Table A.1. Characteristics of High-, Intermediate-, and Low-Performing Sites ..................93
Table A.2. Qualitative Guide for Key Informant Interviews and Focus Groups ...............95
Table A.3. EPOC Report Literature Review Search Strategy ............................................98
Chapter 1. Background and Objectives

Each year, approximately 300,000 people in the United States experience cardiac arrest, and 91 percent of these cases result in death (Cardiac Arrest Registry to Enhance Survival [CARES], 2021; Graham, McCoy, and Schultz, 2015). The total cost of out-of-hospital cardiac arrest (OHCA) care in the United States is estimated to be $33 billion annually (Kida and Ichinose, 2014), and overall survival rates have remained relatively constant over the past nine years (CARES, 2021).

Wide Variation in Response Times and Outcomes

Despite low overall survival rates for OHCA in the United States, some communities consistently report better survival rates; some exceeded 50 percent for bystander-witnessed, nontraumatic cardiac arrest where the patient was in a shockable cardiac rhythm (Seattle and King County Public Health, 2021). What accounts for these differences?

These improved outcomes are believed to stem largely from emergency medical services (EMS) agencies’ adoption of key care processes, particularly the ability to perform high-quality cardiopulmonary resuscitation (CPR) (Graham, McCoy, and Schultz, 2015). Table 1.1 shows other practices and processes contributing to a successful OHCA response and improved OHCA survival, along with citations to research studies that have documented their success.

Although the value of these practices and processes has been demonstrated, little is known about how well and how regularly these processes are used in routine practice and which factors contribute to their successful use. Addressing this gap requires a better understanding of the roles played by EMS agencies and other key stakeholders who provide care during an OHCA emergency.
When an OHCA emergency occurs, victims and their families rely on their community’sprehospital systems of care to mitigate the ensuing threat to the victim’s life and preservation ofneurologic (i.e., brain) function. The prehospital cardiac arrest system of care consists ofnumerous stakeholders working together: bystanders and lay responders; 911 dispatchers andtelecommunicators; public safety officers, police, firefighters, paramedics and other EMSresponse staff; and emergency department (ED) staff. During an OHCA emergency, thesestakeholders must cooperate in a timely, coordinated, and seamless fashion to perform theinterventions needed to save the OHCA victim’s life and brain function. A detailed examinationof the strategies used by systems with high survival rates—across the continuum of OHCA careprocesses—is critical for improving OHCA outcomes.

Existing data indicate that the effectiveness of emergency response systems in responding toan OHCA emergency can vary depending on many factors, such as the availability and proximityof the nearest health care providers to the incident site (Graham, McCoy, and Schultz, 2015;Yasunaga et al., 2011), the EMS staffing models used (Committee on the Future of Emergency
Care in the United States Health System, Board on Health Care Services, and Institute of Medicine, 2007), the level of coordination among stakeholders, and EMS oversight (Committee on the Future of Emergency Care in the United States Health System, Board on Health Care Services, and Institute of Medicine, 2007; Graham, McCoy, and Schultz, 2015; National Association of EMS Physicians, 2017; National Association of State EMS Officials, 2012; Sasson et al., 2010). An effective response also depends on the relationships that EMS systems have fostered with the communities they serve. For example, some community members, such as undocumented immigrants and residents of high-crime neighborhoods, might be reluctant to call 911, which can delay responses and impede access to EMS for vulnerable populations (Finnegan et al., 2000; Sasson et al., 2015; Skolarus et al., 2013; Watts et al., 2011).

This study was designed to address the gaps in understanding of implementation and effectiveness of practices by examining the issues leading to variation among EMS agency performance in responding to OHCA emergencies and identifying strategies for improved OHCA systems of care.

The EPOC Study and Report: Understanding Implementation of Strategies and System Improvement in Diverse Communities

Our strategies were the result of a four-year effort, the Enhancing Pre-Hospital Outcomes for Cardiac Arrest (EPOC) study, that aimed to lay the foundation for future quality improvement in OHCA response (Salhi et al., 2020). The study had two aims. First, we used an integrative systems approach to identify variations in OHCA survival among EMS agencies in Michigan that participated in the Michigan Cardiac Arrest Registry to Enhance Survival (MI-CARES) (Abir, Fouche, et al., 2021). Second, we identified strategies or improved OHCA systems of care based on site visits to a sample of emergency response systems in nine communities across Michigan (Table 1.2).

Table 1.2. Characteristics of High-, Intermediate-, and Lower-Performing Sites in the EPOC Study

<table>
<thead>
<tr>
<th>Urbanicity</th>
<th>Performance</th>
<th>Geography</th>
<th>Transporting EMS Structure</th>
<th>Site Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urban</td>
<td>Intermediate</td>
<td>County</td>
<td>Private, nonprofit, advanced life support (ALS) transporting agency</td>
<td>0</td>
</tr>
<tr>
<td>Urban</td>
<td>High</td>
<td>City</td>
<td>Fire-based, ALS transporting agency</td>
<td>1</td>
</tr>
<tr>
<td>Urban</td>
<td>High</td>
<td>County</td>
<td>Private, for-profit, ALS transporting agency</td>
<td>2</td>
</tr>
<tr>
<td>Urban</td>
<td>Low</td>
<td>City</td>
<td>Fire-based, ALS transporting agency</td>
<td>7</td>
</tr>
<tr>
<td>Urban</td>
<td>Low</td>
<td>City</td>
<td>Fire-based, ALS transporting agency</td>
<td>8</td>
</tr>
<tr>
<td>Urban</td>
<td>Low</td>
<td>City</td>
<td>Fire-based, ALS/basic life support (BLS) transporting agency</td>
<td>4</td>
</tr>
<tr>
<td>Suburban</td>
<td>High</td>
<td>Township</td>
<td>Fire-based, ALS transporting agency</td>
<td>3</td>
</tr>
<tr>
<td>Rural</td>
<td>High</td>
<td>County</td>
<td>Governmental 3rd Service, ALS transporting agency</td>
<td>5</td>
</tr>
<tr>
<td>Rural</td>
<td>Intermediate</td>
<td>Multi-municipality</td>
<td>Governmental 3rd Service, ALS transporting agency</td>
<td>6</td>
</tr>
</tbody>
</table>
To accomplish these aims, we built on the RAND Corporation’s extensive prior work to systematically understand the factors associated with delivering optimal care in other emergency settings (e.g., mass casualty incidents, heart attacks, in-hospital cardiac arrest) and leveraged our team’s multidisciplinary expertise in emergency care, cardiology, clinical epidemiology, and mixed-methods research. We used a mixed-methods approach implementing the following methods:

- We used quantitative methods to identify variability in OHCA survival across the state of Michigan and classify sites as high, intermediate, and low performing.
- We conducted in-depth, semistructured key informant interviews and multidisciplinary focus groups with more than 160 personnel from 911/dispatch, EMS, non-transport fire, and police in emergency response systems with high-, intermediate-, and low-survival outcomes to produce and validate our findings.
- We conducted a review of external literature to determine how the findings of our study might be enhanced or refined by the current academic knowledge on the varied issues across the system of care for OHCA.

Additional information about our approach can be found in the appendix of this report.

The findings from our study were used to construct this report of strategies (the EPOC Report Strategies). We developed a total of 49 strategies covering all levels of the prehospital OHCA incident response and the principles of change management necessary to implement the strategies. These strategies resulted from the qualitative analysis and literature review. Strategies were extracted from the qualitative analysis and organized into a template of system-of-care strategies. Although existing literature established context and supporting evidence for the strategies, a literature review was developed to further assess the strength of each strategy extracted from the qualitative analysis. This report is intended to be used by emergency response systems both within and beyond Michigan through key state and national partners to improve OHCA outcomes in communities across the United States. The common and innovative strategies to improve OHCA outcomes described in these chapters can be adopted by individual stakeholders but are also applicable across the system of care.

Michigan provided a unique opportunity to study OHCA as it has both dense urban communities and rural areas with a diverse population. Each EMS system in Michigan is supervised and coordinated by a Medical Control Authority (MCA). With more than 60 MCAs in Michigan, each is responsible for establishing and enforcing protocols for a particular geographic region. Table 1.2 summarizes, by urbanicity, the characteristics of the high-, intermediate-, and lower-performing sites in the study.

**Organization of the Report**

The chapters that follow present the EPOC report in depth. The remainder of this report is organized in six chapters:
• Chapter 2 delineates the components and levels of community emergency response systems, and how they might vary in structure and capacity in managing the chain of survival.
• Chapter 3 provides a summary of all 49 strategies.
• Chapters 4 through 7 discuss the strategies in detail. Each chapter focuses on a different element of OHCA response and improvement—the incident, stakeholder, and system levels, and the change management process, respectively. In these chapters, quotations from key stakeholders from high-performing systems obtained during the study interviews illustrate the boots-on-the-ground perspective.
Chapter 2. Chain of Survival and Emergency Response Systems

When a cardiac arrest occurs in the out-of-hospital setting, community emergency response systems must act quickly to provide the cardiac arrest patients their best chances of survival.

The American Heart Association (AHA) advocates the six-link out-of-hospital *chain of survival* (Figure 2.1) as a model to represent the essential components of care for cardiac arrest victims in the prehospital setting (Merchant et al., 2020):

- recognition of cardiac arrest and activation of the emergency response system
- early CPR with an emphasis on chest compressions
- rapid defibrillation (i.e., initial electrical shock)
- advanced resuscitation by EMS
- post-cardiac arrest care
- recovery.

![Figure 2.1. Key Steps in OHCA Care: The AHA Out-of-Hospital Chain of Survival](image)

Each community’s emergency response system of care is tasked with implementing these key interventions in the varied environments where OHCA occurs (e.g., the home, the workplace, public locations). The chain of survival must be executed by multiple stakeholders (e.g., bystanders and lay responders; 911 dispatchers and telecommunicators; public safety officers, police, firefighters, paramedics and other EMS response staff; and ED staff) across five emergency response phases that are common to all prehospital systems: *activation, pre-arrival, on-scene, transport, and ED handoff* (Figure 2.2). Which stakeholders carry out these critical interventions in the chain of survival can vary in different communities; however, these systems almost always rely on multiple parts that work together to facilitate optimal care.
The Diversity of Emergency Response Systems

Every prehospital system of care is unique. There is an old adage in the EMS that says, “If you’ve seen one EMS system, you’ve seen one EMS system.” There is no single standard in how emergency medical response systems are structured. In some communities, all EMS care is provided by the fire department; in others, private organizations provide these services; in still others, EMS are administered by the police. Generally speaking, prehospital systems of care consist of community members who recognize the emergency, emergency call center(s) that receive the information and can guide the caller, some organization(s) that provide non-transporting initial medical care, and transporting agencies that operate ambulances and deliver the patient to the hospital. Both incident-level and agency-level factors affect how emergency response systems function across the five emergency response phases and with each prehospital system stakeholder (Figure 2.3).

Understanding who makes key decisions in a given system will be essential to any improvement efforts. We advise stakeholders in EMS systems to systematically consider these questions to develop a comprehensive and explicit understanding of their own regional structure:

1. **Determine the geography of the system that is the focus of quality improvement.** What municipalities (e.g., cities, townships, villages) does the system include? Does it include the entirety of all those places or just parts of them? What is the population density of the region that will be served? A system designer might want to consider the system in terms of the jurisdiction their agency covers, or a whole county, or a single city.

2. **Determine which 911 centers operate within the system’s geography.** These are called public safety answering points (PSAPs), and there might be one point or multiple options. Determine what services (i.e., police, fire, EMS) that a PSAP is able to dispatch. Do the PSAPs provide medical call-taking services (i.e., can someone talk a caller through caring for a medical emergency prior to the arrival of first responders)? Also, determine whether any of the primary PSAPs transfer callers to a different call center under certain circumstances. For example, some centers will transfer cardiac arrest calls to a different center that has training on how to instruct performing CPR over the phone.
3. **Determine what police and non-transport fire departments operate in your geography.** This determination needs to include other types of first responders, such as federal or state police units, lifeguards, nursing home staff, security guards, athletic trainers, park rangers, and ski patrol. Determine how frequently they respond to cardiac arrest emergencies. Also determine their level of medical training. First-responder medical training can vary significantly. First responders might be untrained or trained in basic first aid and CPR as medical first responders (MFRs) or emergency medical responders (EMRs). They might be trained even further as emergency medical technicians (EMTs), advanced emergency medical technicians (AEMTs), or as paramedics.

4. **Determine who provides primary transporting EMS (i.e., ambulances) for 911 responses in this geography.** This can vary tremendously. It can be a governmental, fire-based, police-based, private for-profit, private nonprofit, or hospital-based agency. There is also a need to determine the level of care provided by each and the training of the staff for these transporting EMS providers in the emergency response system.

5. **Consider the EDs that are most commonly used in the emergency response system.** Are they part of the same health system or different ones? What level of care can they provide? Are they designated cardiac arrest centers? Can they provide key services for cardiac arrest, such as cardiac catheterization services, therapeutic hypothermia, open-heart surgery, extracorporeal membrane oxygenation (ECMO), and intensive care services?
6. **For each of these stakeholders, determine who is responsible for oversight and decisionmaking regarding the medical care each group provides.** Is there a physician medical director who oversees all of these agencies or are there multiple directors? Creating a comprehensive list of those responsible for prehospital care oversight can help with effectively engaging these stakeholders in improving OHCA care.

One approach for evaluating these questions could involve a retreat or workshop where key stakeholders meet to reflect on these questions, one at a time or in groups, and report back. This could lead to a comprehensive characterization of the system.

This information helps elucidate how simple or complex the existing emergency response system is and can inform how, where, and by whom strategies for improving OHCA response should be implemented.

**The OHCA Response “Machine”**

Throughout this report, we will use the analogy of a machine to describe how these stakeholders need to work together to save lives.

Many machines consist of parts (e.g., gears, shafts) that work together to accomplish a task. The parts of a well-designed and well-functioning machine all play a role transforming inputs into valued outputs. They must all work together to make that happen; no one part of the machine does it all. The cog without the shaft or another cog to spin, no matter how perfectly cut or carefully lubricated, will spin on its own, producing nothing. At the same time, a fully integrated machine could be limited by its weakest or most vulnerable component; if one part breaks down or functions poorly, the system might be severely hampered or even fail.

In the context of OHCA response, the prehospital system of care is the machine (Figure 2.3). Cardiac arrest victims are its inputs, and the survival of neurologically intact patients are its ideal outputs. Its key components (i.e., the cogs and shafts) are the stakeholders—such as bystanders and lay responders; 911 dispatchers and telecommunicators; public safety officers, police, firefighters, paramedics and other EMS response staff; and ED staff—who implement the chain of survival. None of the responder groups creates the output individually, but outcomes can be optimized through skilled care and seamless coordination and transitions between components. The text box describes the components of the prehospital system of care.

The process of saving a life during an OHCA emergency can be thought of as akin to moving a product through a machine. We understand that lives are much more valuable than products. However, the best machines—including community response systems for out-of-hospital care—need designers and mechanics to design and build them. This report is a guide for the designers and builders of the prehospital system of care, such as concerned citizens, public safety providers and/or supervisors, medical control providers and prehospital care champions, and other potential users. Although this metaphor is imperfect, we believe it provides value for stakeholders to understand how they can make focused and actionable improvements in their own systems.
Developed through interviews and focus groups with more than 160 telecommunicators, first responders, prehospital system administrators, cardiac arrest care system champions, nurses, and physicians, this report outlines what needs to happen for OHCA patients at the incident level, how to optimize the parts of the system at the component or stakeholder level, and how it should all fit together at the system level. The report breaks down each of these levels and provides strategies that stakeholders can use to optimize prehospital OHCA care across the system. Finally, the report offers suggestions on the process for making changes to emergency response systems.
Parts of the Prehospital System of Care

Community
Bystander: A person who witnesses or encounters an emergency situation
Lay responder: A bystander who provides medical intervention prior to the arrival of first responders
Medical lay responder: A medically trained bystander who provides medical intervention prior to the arrival of first responders

Dispatch
Call taker: 911 professional responsible for answering 911 calls and interfacing with caller
Dispatcher: 911 professional responsible for using information collected by 911 call takers to allocate emergency resources and manage the resource needs of responding units
Telecommunicator: 911 professional in general

Emergency Responders (i.e., Early Responders, Advanced Life Support, Transport)
Emergency Responder: A person actively working for a public safety agency, who responds to emergencies professionally (i.e., telecommunicators, police, firefighters, EMT/paramedics) whether for pay or as a volunteer
Police officer: A sworn officer of a law enforcement agency at any level (local, state, federal); often mobile-deployed throughout the community in patrol vehicles
Police chief: The police head of a law enforcement agency
Firefighter: A sworn employee of a fire service (local, state, federal) who is trained to use fire suppression and rescue equipment to preserve life and property during emergencies. Firefighters are typically housed at stations that are strategically located throughout the community to ensure a rapid response by emergency services. Firefighters are frequently cross-trained in an EMS role
Fire chief: The firefighter head of a fire service organization
Public safety officer: An emergency response professional hired by a unified public safety department who is cross-trained in and performs duties associated with law enforcement, fire and rescue services, and emergency medical response
EMR or MFR: Synonymous term for an introductory level of EMS licensure (Non-EMS first responders—e.g., police, fire—are commonly trained to this level.)
EMT: Second level of EMS licensure
AEMT: Middle tier of EMS licensure; can typically initiate intravenous (IV) therapy
Paramedic (EMT-P): Highest level of EMS licensure; can perform ECG interpretation, intubation, full advanced cardiac life support (ACLS)

Hospital
ED staff: Nurses and patient care and other technicians who staff an ED
ED providers: Physicians, nurse practitioners, and physician assistants/associates who direct and manage patient care in the ED
Medical control: A physician who can provide orders to a responding EMS crew in real time via telecommunication
Medical direction: Physician(s) responsible for general oversight of the medical care provided by an EMS agency

Advocates
OHCA champion: An individual who seeks to improve a community’s survival through an understanding of the whole system (i.e., the whole machine, the whole field) and through engagement and care of all its component parts
OHCA coordinating committee: A multidisciplinary group of OHCA champions gathered for the purpose of systemwide improvements in OHCA response and management

The strategies in this report were identified during the course of qualitative interviews with prehospital emergency responders and their organizational leadership. Strategies leveraged by one agency in a unique system of care may not have the same effects in other systems. Additionally, in many cases, the literature and data currently published regarding these strategies is limited or inconclusive; therefore, this document is a starting point for system officials to consider refining practices in consultation with medical control personnel.

The first discussion in this report centers on what needs to happen among on-scene responders during a cardiac arrest and when it should happen (see Figure 3.1 and the related text box). We discuss the essential components of care using emergency response phases that align with the links in the chain of survival. We begin with the activation phase and then move in sequence through the phases of pre-arrival, on-scene (including early professional response and full resuscitation team sub-phases), transport, handoff, and debrief.

**Figure 3.1. Incident-Level Factors Components of Care**

**Incident-Level Factors (Toolkit - Part 1)**

NOTE: ROSC = return of spontaneous circulation.
Emergency Response Phases

**Activation Phase:** This is the earliest component of the emergency response. This is when someone recognizes that an emergency is occurring and contacts emergency authorities to initiate an emergency response. This phase aligns with the first link of the *Chain of Survival: Recognition/Activation.*

**Pre-Arrival:** After emergency crews are dispatched, there is a period of time where the only interventions that can occur are as a result of bystander actions. During this phase, dispatch might deliver instructions for how bystanders can assist a cardiac arrest patient. This phase aligns with the second and sometimes the third link in the *Chain of Survival: Early CPR and Rapid Defibrillation.*

**On-Scene:** This phase consists of two sub-phases: early professional response and full resuscitation team. The phase begins when the first professional emergency responder has arrived on scene. This phase starts with an early professional response component with limited resources and later involves a full resuscitation team with a complete assortment of advanced interventions that can be used to care for the patient. The early professional response component often aligns with the second and third link in the *Chain of Survival: Early (High-Quality) CPR, and Defibrillation,* while the full resuscitation team component encompasses the fourth and fifth links: Advanced Resuscitation and Post-Cardiac Arrest Care.

**Transport:** This phase begins when the on-scene crews move the patient to the ambulance and the patient is transported to a medical facility. Typically, this occurs after pulses are regained, but sometimes this is not the case. This phase generally focuses on Post-Cardiac Arrest Care; however, if the patient re-arrests in the back of the ambulance, the crew will revert to the *on-scene* interventions.

**Handoff:** This phase marks the end of the prehospital portion of care as a transition of care occurs between the transporting EMS crew and the ED team. Typically, the *handoff involves* maintenance of post-ROSC care, but it is also complicated by unstable patients who might re-arrest.

**Debrief:** In this phase, members of the care team take time to reflect on a particular incident and learn from things that went well and that could have gone better and to identify corrective actions to improve future responses. Finally, this phase looks at all components of the chain to assess their performance.

**Activation Phase**

During the *activation phase* (Figure 3.2), OHCA victims rely on family members and friends, bystanders, or medical facility staff (e.g., in a nursing home) to recognize that an emergency has occurred and to activate the system of care. This is usually done by a witness calling 911 and then being routed to a PSAP and answering the emergency call taker’s questions. During the activation interaction, the dispatch team must use the caller’s knowledge, cell tower triangulation, or GPS technology to locate the scene of the emergency, understand the nature of the emergency, and dispatch the appropriate units.
In a modern high-performing cardiac arrest response system, during the activation phase, 911 centers should be able to use modern telecommunication technologies to rapidly identify the location of the emergency, use technology and protocols to quickly diagnose the emergency, and deploy the closest available units from various institutions to the scene as quickly as possible.

**Activation Phase Strategies**

The activation phase includes Strategies 1 through 6:

1. Use modern location identification technology to find the emergency.
2. Leverage tools to improve recognition of cardiac arrest by public and frontline providers.
3. Conference callers to dispatch centers rather than transferring them.
4. Send responders from different disciplines to reduce response times.
5. Dispatch the closest qualified units, regardless of jurisdiction.
6. Advocate payment models that eliminate or reduce charge on patients for high acuity emergencies.

**Strategy 1. Use Modern Location Identification Technology to Find the Emergency**

Typically, the first question that a 911 call taker will ask is “Where is the emergency located?” Many people assume that 911 can easily locate callers with smartphone technology. Unfortunately, in many cases, 911 services operate on limited technology that can only provide a general sense of a caller’s location (Cohen, 2019; DeMarco, 2018). Upgrades to and implementation of better technological infrastructure that can support more-accurate location technology might improve the time to emergency services arrival in OHCA response.¹

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¹ Throughout the next several chapters, we include quotations from key stakeholders from high-performing systems obtained during the study interviews illustrate the “on the ground” perspective. For descriptions of the sites where the speaker was located, see Table 1.2.
Well, in the past, if you didn’t have a cell phone and you were out in the woods, you had to run up to the house and use a landline and then when cell phones came out, the location accuracy was not quite there and now . . . we can pinpoint somebody within meters of where they’re standing, so we know where they’re at. For the most part, it’s built in if they have a new enough phone.

—Dispatch mid-level manager, Site 5

Although some challenges in determining the caller’s location—such as Federal Communications Commission rules and the decisionmaking of cellular device and network companies—remain outside the hands of locally governed dispatch centers, PSAPs can leverage such a platform as RapidSoS® to more accurately locate callers. RapidSoS® allows PSAPs to use the location technology available on smartphones to obtain more-accurate locations than can be assessed using traditional triangulation methods. As technology progresses, the implementation of such platforms as RapidSoS, along with enhancements in 911 and telecommunication infrastructure, will continue to improve the capacity of PSAPs to collect information about emergency scenes.

Strategy 2. Leverage Tools to Improve Recognition of Cardiac Arrest by Public and Frontline Providers

Before appropriate care can be provided for a patient in cardiac arrest, the nature of the emergency must be recognized. Having a systematic approach to identifying OHCA is important and there are several types of approaches including early dispatch identification, implementation of a dispatching system, utilizing a standardized approach to call taking, identifying an algorithm for cardiac arrest over the phone, and assessing breathing. One study reported that accurate and early dispatch identification of cardiac arrest has been associated with a threefold increase in the chance of survival for OHCA victims (Berdowski et al., 2009). However, other systems saw nonsignificant results following implementation of dispatching systems (emergency call handling systems used to provide pre-arrival instructions and dispatch aid to medical emergencies), further highlighting the unique nature of individual emergency response systems (Mapp et al., 2020; Travers et al., 2014). At the incident level, use of a standardized emergency medical dispatching program is associated with higher rates of cardiac arrest recognition (Heward, Damiani, and Hartley-Sharpe, 2004). Later sections of this report will cover implementation of training for emergency medical dispatchers (EMDs) and dispatch as a key component of OHCA response.

The AHA, the National Emergency Number Association, and Resuscitation Academy all recommend that 911 centers use a formal (i.e., structured) approach to OHCA call taking. There is some debate over the best algorithm for identifying cardiac arrest over the telephone (International Academies of Emergency Dispatch, 2021; Clawson and Patterson, 2021), but the general consensus is that any structured approach is better than none (AHA, undated-c; Drennan...
et al., 2021; Kurz et al., 2020). Additionally, some international studies have suggested that asking the caller to place their hand on the victim’s abdomen to assess breathing enhances recognition rates for cardiac arrest (Mao et al., 2020). Some common dispatching systems used in the United States are:

- Medical Priority Dispatching System™ (MPDS)
- Association of Public-Safety Communications Officials (ACPO) International
- PowerPhone
- King County Criteria Based Dispatch (Sutter et al., 2015).

In recent years, some cities have created their own dispatching systems (e.g., the Los Angeles Tiered Dispatch System in California) (Sanko et al., 2020). A key informant described how dispatchers at one high-performing site work as a team when initially screening the call to determine the nature of the emergency, identify any immediate life threats, and dispatch appropriate resources:

“Where is your emergency?” is usually their first question, and after the address was given, they said, “we have a person here who’s not waking up . . . ” They immediately know that they’re dealing with a medical problem . . . . [T]hat dispatcher turns it over to the medical dispatcher . . . . The first dispatcher stays on the line and listens . . . . [T]hey’re looking for key words like anything to do with breathing, altered level of consciousness or anything, chest pain.

—Non-EMS fire staff member, Site 2

Emergency protocols are available in both card set and emergency software versions, though software packages offer a more complete suite of cardiac arrest detection and management features. Software packages can be prohibitively expensive for some communities, but they are worth examining as a means of further standardizing dispatch practices and limiting center liability.

Strategy 3. Conference Callers to Dispatch Centers Rather Than Transferring Them

Some systems have multiple PSAPs who specialize in different types of emergencies or only cover certain jurisdictions. When there is not a centralized PSAP to handle all emergency calls, 911 callers will inevitably have to be directed by their initial call taker to the call taker who is most appropriate according to the caller’s location and the nature of their emergency. When this happens, key information and critical time can be lost as the caller has to wait for the transfer process to occur and must repeat all the information they shared with the first call taker. To ensure that information is shared correctly and the caller receives the appropriate resources, call takers should, at a minimum, initiate a handshake conference in which both the initial call taker and the second call taker are on the line together with the caller for a brief period. According to
an EMS administrator in a high-performing system, their site uses handshake conferences to ensure the completeness of the caller transfer:

One of the nomenclatures I’ve been trying to change over the years is they don’t transfer the call, they conference. It’s a three-way conference. So it’s never dropped. They stay on until we announce the priority, and then they drop because transferring scares people . . . . [H]ow do you know it actually ever went over there? It’s a handshake conference.

—EMS administrator, Site 2

Beyond handshake conferences, dispatch centers should implement integrated computer-aided dispatch (CAD) systems that allow digital information (e.g., location, history, call notes, locations notes) to be pushed from one center to the other.

Strategy 4. Send Responders from Different Disciplines to Reduce Response Times

Communities that dispatch multiple emergency responder units—such as police, non-transport fire, and EMS—to cardiac arrest emergencies can often reduce response times and get help to the scene faster. In many places, law enforcement is particularly well positioned to respond rapidly to cardiac arrest emergencies because of their mobile deployment. In places where law enforcement does not fill this role, communities seeking to improve their OHCA care should determine who does fill this “mobile-deployed” role. At an incident level, dispatching resources beyond an ambulance will achieve initiation of care to the patient faster and can decrease time to such critical interventions as defibrillation. This is especially true in rural communities, where resources are more sparsely deployed. This multi-deployment approach also has the effect of getting sufficient personnel on scene rapidly for optimal care delivery. A key informant highlighted how police officers on the road are often first on scene:

Our officers are out on the road as opposed to having to respond from the station here and generally sprinkled throughout the area, so yeah, we’re going to get there, more often than not, first.

—Police and dispatch administrator, Site 3

Furthermore, an individual from one site explained that they dispatch numerous stakeholders to the scene of an OHCA, including law enforcement (i.e., public safety, fire, transporting EMS, and a field physician unit):
Once we know the [incident] priority, the primary PSAP dispatcher will drop off; we’ll page fire, first responders, or public safety because [City 1] has public safety as well. And then we obviously dispatch our ambulances. We also dispatch [Medical Unit 1], which is the residents, and fellows [who] also respond to our prehospital cardiac arrests in [City 1].

—EMS administrator, Site 2

Several studies have indicated that dispatching first responders in addition to transporting EMS improves response times and outcomes for cardiac arrest victims (Hasselqvist-Ax et al., 2017; Nordberg et al., 2015; Raun et al., 2019; Saner et al., 2013). System champions consult with dispatch administrators to determine whether their dispatch agencies have policies in place to ensure that all stakeholders that might help are notified and sent to the emergency in a timely fashion. Some systems have even gone as far as implementing smartphone applications, such as PulsePoint and GoodSAM, to dispatch CPR-trained citizens to these emergencies (Chomicz, 2019; GoodSAM, undated).

Strategy 5. Dispatch the Closest Qualified Units, Regardless of Jurisdiction

An additional strategy to provide more-rapid access to care is to dispatch the closest unit to the event. One study site discontinued jurisdictionally based dispatching and instead implemented proximity-based dispatching following the death of a patient who was closer to one fire department than the one that responded:

A gentleman had actually suffered cardiac arrest and his local fire department that was closest to his home was not in his tax bracket jurisdiction. So that’s what started the [closest unit response code program]. Because the fire department who did respond was further away even though there was one closer, that’s not their call, it doesn’t belong to them. So, unfortunately, through that, evolved our [response code] to remove the barriers . . . . [W]hen we declare a [closest unit response code], that PSAP will actually tone out across the countywide channels.

—Dispatch staff, Site 2

Implementation of this program would require agreements between neighboring jurisdictions and their respective dispatching organizations. There are communities that already have this type of automatic aid policy in place for response to house fires (City of Glendale, California, undated). System leaders can consider leveraging existing infrastructure to implement this response configuration.
Strategy 6: Advocate Payment Models That Eliminate or Reduce Charge on Patients for High-Acuity Emergencies

People sometimes hesitate to activate the emergency response system when they are experiencing or witnessing signs and symptoms of a cardiac emergency because of concerns about the cost of using EMS (Cannoodt, Mock, and Bucagu 2012; Rosato, 2021). That delay in accessing care might contribute to the deterioration of the patient’s condition, and, in the case of an OHCA, can be fatal. One dispatcher in our study noted occasional hesitation from the community because of the financial burden of ambulance services:

I think we try as a 911 controller to steer away from the financials and the—yes, we are a private ambulance industry, but you know what? There’s a problem here; let’s address the problem. Money right now, I don’t even care, I’ll still help you if I were on the street, so we try to remove that. There are times where you hear, well, I called 911 for so-and-so and I got the bill. Probably not, so we try to remove that [barrier]—and then we get compliance out of the caller.

—Dispatch staff, Site 2

Systems champions should explore the extent to which financial barriers limit access to EMS care. Furthermore, it is important to consider investigating and implementing modified payment models for high-acuity emergencies that reduce the barriers to activating the emergency response system for life-threatening emergencies.

Activation Phase Conclusions

Implementation of these strategies to ensure quick access to location information and rapid dispatch of needed resources should get units on the road faster and get faster care to the person who needs it. The next section outlines what needs to happen while professional responders are on the way to the scene—at dispatch, around the patient, and in the responding vehicles.

Pre-Arrival Phase

In the pre-arrival phase (Figure 3.3), units have been dispatched to the scene but have not yet arrived. For a cardiac arrest emergency, units will be dispatched with a lights and sirens (L&S) response. Patient care is dependent on the lay responder’s skills and what they can be coached by the call taker to do. In an OHCA, lay responders might be repositioning the patient, performing CPR, or applying an AED. If the OHCA was associated with overdose, the lay responder might also be providing a naloxone (e.g., NARCAN®) nasal spray.
In a high-performing system, 911 telecommunicators would use specialized software to continue collecting information about the emergency, coach the caller through the provision of immediate care and preparation of the scene for emergency responder arrival, and provide responding units with scene updates. In the vehicles responding to the incident, crews must formulate a game plan and prepare themselves to act prior to arrival, while receiving updates from dispatch and other units arriving on the scene.

**Pre-Arrival Phase Strategies**

7. Provide 911 callers with pre-arrival instructions for scene preparation and CPR/AED use.
8. Develop processes for dispatch to provide updates to responding units as additional information from the scene becomes available.
9. Foster the practice of *game planning* and preparing necessary equipment while responding to the scene.

**Strategy 7: Provide 911 Callers with Pre-Arrival Instructions for Scene Preparation and CPR/AED Use**

Early bystander CPR is linked to improved outcomes, and the implementation of telecommunicator CPR instruction or telecommunicator CPR (T-CPR) has been shown both to improve bystander CPR rates and improve outcomes (Kurz et al., 2020). The AHA now considers it a standard of care (AHA, undated-d). Unfortunately, a 2015 survey of PSAPs across the United States found that only 51 percent reported providing T-CPR (Sutter et al., 2015). We were unable to locate more recent evidence to determine whether things have improved since then.

Having a standardized process by which to implement this intervention is essential. Emergency telecommunicators must keep track of a tremendous number of tasks and details. The call center must process information flow between the responding units and the emergency scene and operate numerous technologies simultaneously while managing often chaotic situations that
they only hear about over the phone. Using a standardized process for management of these emergencies is a critical support that can help telecommunicators manage their workload. Without one, important details can be missed:

I remember doing a cardiac arrest over the phone at [University 1] and the guy was in the parking lot and I didn’t even bother with AED question, and two seconds later, it was like, hey, there’s an AED right in that door, and I’m like, oh, I feel [like] an idiot, because I’m assuming he’s in a parking lot, there is no AED available, so I wouldn’t ask that. But it’s still an instruction we are supposed to give, and I skipped it and two seconds later it’s like, oh . . . . So, awareness, ask, push.

—Dispatch staff member, Site 2

Although expensive, dispatch staff felt that having an emergency medical dispatch system—which allows telecommunicators to identify the medical emergency, dispatch services quickly, and provide instructions to callers—would help limit their liability and make them more comfortable providing instructions:

You know, an emergency medical dispatching program would be nice, but you know, those are really, from what I’ve heard, they’re very expensive. You get trained as an emergency medical dispatcher . . . . [Y]ou’re certified to ask those questions and you’re certified to give them the help on the phone . . . . Coming from [City 1] where everybody sued everybody for anything they did wrong, you’re reluctant to do stuff on the phone, especially if you’re not certified in it because they will come back at you if something happens . . . . I haven’t had this proper training. If . . . something goes wrong, is it going to come back on me? . . . . Not having a certification, a proper training like that, kind of leaves that . . . . leaves yourself open a little bit.

—Dispatch staff member, Site 6

High-performing cardiac arrest response systems need to have some means of reliably providing these pre-arrival instructions to callers in need. Because T-CPR is now considered a standard of care, failure to provide these might constitute a greater liability to dispatching agencies (Kurz et al., 2020). There are several options for paying for T-CPR, such as 911 surcharge funds, state training funds, in-kind forms of support, and leveraging a state tobacco tax levied to collect public health funds (National Highway Traffic Safety Administration, undated-b).

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2 Video-911 has been implemented in a limited capacity in a few systems, but this technology is still in its infancy.
Strategy 8: Develop Processes for Dispatch to Use to Provide Updates to Responding Units as Additional Information from the Scene Becomes Available

Updated information regarding changes in patient status, scene safety and access concerns, bystander actions, and the activities of other first responders can all help responding units prepare for arrival at the scene. It is important that dispatch be able to relay this updated information to all responding units in real time. This might be done via dispatch notes to devices with the responding units or via radio communications. One fire agency described how they notify other responders via dispatch if a cardiac arrest is discovered on arrival on scene:

> What we do is, we will call the county dispatch over the radio when we confirm it’s a full arrest. If the dispatch on scene is any different from what we were originally dispatched to, we’ll ask them to tone it out again to let our people know that this isn’t an unresponsive person. This is a cardiac arrest and we need help, we need more people.

—Firefighter, Site 2

Systems that have telecommunicators from multiple disciplines in the same centralized location have an advantage in this kind of information-sharing because messages can quickly be relayed between stakeholder groups. Systems that house their telecommunicators in separate locations must overcome additional logistical challenges to ensure that different stakeholders can communicate updates efficiently. One solution to this challenge is asking all units responding to the event to switch to a shared radio channel and use universally understood language (i.e., instead of radio codes) so they can communicate effectively. System champions (e.g., stakeholders interested in improving OHCA care) should investigate the dispatch structures in their communities to determine how these communications can best be streamlined.

Various resources exist that allow individuals to register with the PSAP and input critical information in advance of an emergency. This can help dispatchers identify potential conditions and medical information that responders should be aware of as they respond to a 911 call. Dispatchers need to ensure that the information transfer occurs as seamlessly as possible. During a site visit, a dispatcher noted that they are in the process of seeking out ways to streamline and consolidate CAD systems with regional partners. This interface eliminates rework (e.g., retyping call information) and reduces the overall time required to dispatch resources.

Strategy 9: Foster the Practice of Game Planning and Preparing Necessary Equipment While Responding to the Scene

While en route or before the alarm ever goes off, emergency responders should be planning out their individual roles on scene. For a fire department, this might mean that a company officer assigns one firefighter to chest compressions, another to AED application, and another to airway management. They should also plan for the equipment they’ll need to bring in and determine
who will carry what where. A key informant stated that EMS crews discuss cardiac arrest care
and set up roles during morning roll calls:

> Have your roles set up, we’ve been telling them in the morning—during your
morning discussion, your morning roll call at some point, get with everyone on
the crew, “if this happens, this is what we’re going to do.”

—Fire-based EMS mid-level manager, Site 4

Another highlighted that failure to bring appropriate equipment can lead to delays in care:

> They came up with a jump bag. They didn’t have an AED on them at the time or
a backboard, so they had to go back to the vehicle and retrieve those items to
come back up.

—EMT, focus group, Site 4

Different units might discuss different topics and prepare different equipment. A BLS non-
transporting unit might discuss who will prepare the AED, who will provide chest compressions,
and who will manage the airway. Advanced life support units might determine who is going to
be the attending provider, who will manage drugs, or who will manage the monitor. They might
examine the dispatch notes for clues as to the cause of the cardiac arrest. A transporting unit
might start thinking about what center might be most appropriate for transportation.

Finally, any cardiac arrest equipment that can be prepped en route to the call should be
prepared. This might mean donning personal protective equipment (PPE), positioning equipment
for quick deployment, and preparing documentation forms. Thought should also be given to the
setup of equipment within the vehicle. System champions should ask whether cardiac arrest
equipment is positioned in all units for rapid deployment.

**Pre-Arrival Summary**

In high-performing systems, action by dispatch and bystanders on scene during the pre-
arrival phase will help improve a patient’s chance of survival. Similarly, preparedness and
planning by crews en route will ensure more-seamless care delivery when they arrive at the
emergency. In the next section, we discuss what optimized care on scene should look like.

**On-Scene Phase**

The *on-scene phase* (Figure 3.4) begins when the first emergency responder (e.g., police
officer, firefighter, paramedic) arrives at the location of the emergency. This first unit on scene
could be from any type of public safety agency depending on system policies, dispatch practices,
mutual/automatic aid agreements, location of the incident, unit availability, and deployment.
OHCA actions and interventions performed during this phase depend on the number of units that have arrived and their training and capabilities. The phase progresses through two sub-phases reflecting a resource spectrum that ranges from the minimally resourced early professional response (one or two responders on scene, usually with BLS capabilities) to the highly resourced full resuscitation team (five or more responders, usually with advanced life support capacities). Units typically arrive in stages, with one or two personnel initially arriving on scene and additional units arriving in sequence. As more units arrive, more capacity to intervene becomes available until there are sufficient units to complete all necessary on-scene tasks for a full ACLS response.

It is important to note that even in an individual system, a standard response sequence does not really exist because of the numerous factors at play. During the early professional response sub-phase, there are only a few people who have arrived; priority interventions, such as CPR and defibrillation, will take place regardless of who is on the scene. As more people arrive to help, on-scene practices begin to reflect the capabilities of a full resuscitation team, in which the number and training of staff are sufficient to allow the team to perform each action.

In high-performing systems, high-quality CPR begins as soon as the first professional arrives at the patient’s side and, once started, is maintained throughout the resuscitation. Additionally, there is seamless, clear, and professional communication between responders throughout the incident.

**General On-Scene Strategies**

Strategies 10 through 13 address the on-scene phase:

10. Provide high-quality and high-performance CPR throughout the incident.
11. Foster effective on-scene communication and a culture of constructive feedback.
12. Adapt the scene or patient positioning to facilitate care.
13. Use modern clinical equipment effectively and appropriately.
Strategy 10: Provide High-Quality and High-Performance CPR Throughout the Incident

Regardless of the type of responder on scene, all CPR provided during an OHCA resuscitation effort should adhere to the principles of high-quality CPR (see the related text box). That is, providers must ensure that the patient is adequately positioned on a firm surface, interruptions to CPR are minimized, the recommended rate of compressions is maintained (100–120 per minute, or 80 per minute with certain active decompression devices), adequate age-appropriate depth is maintained, and full chest recoil is permitted with each compression (Panchal et al., 2020; Resuscitation Academy, 2020). Additionally, ventilations without a secured airway device must ensure an adequate bag-valve-mask (BVM) device seal, which requires two rescuers as a strategy (Lyng et al., 2022). For example, a key informant mentioned compression quality as a priority for a high-performing site:

Quality compressions are important, and I think that that shift is happening in most of the conversations . . . . For the fire department end of it, if you can just improve your CPR quality and . . . if you could just pay attention to the fine details and don’t stop, don’t be off the chest for more than ten seconds, those little things.

—Paramedic, focus group, Site 3

High-Quality and High-Performance CPR

- Chest compression fraction more than 80 percent of resuscitation duration
- Compression rate of 100–120 compressions per minute
- Compression depth of at least 2 inches in adults and at least ⅓ the front-to-back dimensions of a child or infant’s chest
- Full recoil of the chest cavity with each compression
- No excessive ventilation
- Positioned on back, on a hard, flat surface.

The implementation of rigorous high-quality CPR programs has led to improved cardiac arrest survival and system performance in numerous emergency response systems across the country (AHA, undated-a; Heart Rescue Project, undated-a; Meaney et al., 2013). There are excellent resources on the implementation of high-quality CPR at CPR LifeLinks and Resuscitation Academy (National Highway Traffic Safety Administration, undated-b; Resuscitation Academy, undated).

An additional model related to high-quality CPR to consider incorporating into an emergency response system is high-performance CPR and its progenitor, pit-crew CPR, which takes a team-focused approach to providing high-quality CPR and other advanced interventions, while the high-performance CPR is driven by metrics. The pit-crew CPR model has been associated with improved survival and neurological outcomes for cardiac arrest patients (Hopkins et al., 2016).
Although high-performance CPR is still loosely defined, a 2021 systematic review found studies using this term and those implementing similar CPR models were associated with improved patient outcomes (Ng et al., 2021).

**Strategy 11: Foster Effective On-Scene Communication and a Culture of Constructive Feedback**

For the on-scene response to smoothly transition from the early professional response sub-phase to the full resuscitation phase and move forward to the transport phase, there must be continuous, succinct, and pertinent communication among responders and ongoing assessment of progress with appropriate correction:

![Quote](I think our shift has been really good about keeping—especially when you got seven guys in a small area . . . the communications just to exactly what’s pertinent . . . I don’t need any extraneous information . . . [W]e’re much better than we used to be about just having the pertinent information being relayed back and forth.

—EMS mid-level manager, Site 3)

![Quote](One of the challenges that he discussed was . . . people kind of taking offense [to criticism] . . . We have a team mentality to taking care of patients and . . . if somebody looked at me and said you’re not quite doing that right, can you try this? . . . I don’t take offense to that . . . I think that that should be part of the training. Hey, we’re all going to be looking at each other while we’re providing this care, while we’re providing CPR, we’re paying attention. Are you getting that 2-inch compression, ya know?

—Paramedic, focus group, Site 0)

High-performing systems should prioritize effective communication and acceptance of real-time feedback from all members of the response team. Additionally, one study of in-hospital cardiac arrest found that frequent communication between a code leader and the documenter facilitated the development of a shared understanding of the situation for the whole code team (van den Oever and Schraagen, 2021). Therefore, it might be beneficial to ensure that this communication occurs regularly in the out-of-hospital setting. These themes have been identified as critical in other high-performance settings and are a key feature of Crew Resource Management, a training developed for aviation crews with a focus on group dynamics, interpersonal communication, and decisionmaking (American Psychological Association, 2014). This model is now being adapted for use in the hospital, ED, and prehospital settings (American Psychological Association, 2014; Seidel, 2019).
Strategy 12: Adapt the Scene or Patient Positioning to Facilitate Care

As soon as an emergency response professional arrives on scene, they should move the patient (if feasible) to an optimal position to facilitate care. The professional should remember that the patient needs to be positioned not only so that they can be accessed but also with adequate space so that a full resuscitation team and all of their associated equipment can eventually work on the patient. Responders might need to move the patient from a sofa, bed, chair or narrow space that prevents patient access. In many cases, this can be done by the first unit on scene, but under certain circumstances (e.g., an especially heavy or wedged patient), more personnel might be necessary. As more responders arrive, they might also move furniture to create additional space to facilitate the eventual egress of the patient and providers. A cardiac arrest in such a location must typically be moved to a different room to provide the patient with adequate care. One key informant’s department specifically trains their staff on the practice of modifying the patient’s location to maximize performance:

> We train our staff to move the patient for success. Most of the time when we find a patient in cardiac arrest, they are in the absolute worst possible location—between the toilet and the vanity in the bathroom and things like that. So, we found that, a lot of times, cardiac arrests are started there. We do not do that. The first thing we do is move the patient to an area where we can work. We want our rescuers to be right across from each other, so we want [enough] space [that,] when we switch rescuers, they don't have to get up and change rescuers or just [go] back and forth.

—Fire-based EMS administrator, Site 3

Strategy 13: Use Modern Clinical Equipment Effectively and Appropriately

Cardiac arrest resuscitation technology has undergone marked advances since the first portable defibrillator was introduced in 1957 and CPR was formalized in 1960 (AHA, undated-b). Modern resuscitation teams have more options regarding the care that they can provide, with numerous CPR adjuncts now available to public safety agencies across the country. Among these options are mechanical CPR (e.g. LUCAS®, AutoPulse®), impedance threshold (e.g. ResQPod®), and manual active compression-decompression (e.g. ResQPump®) devices. Responders in some systems now arrive equipped with intraosseous (IO; i.e., through-the-bone) drills (e.g. EZ-IO®) that give them another means of obtaining access to the body’s circulatory system, as well as devices that provide real-time feedback on the quality of compressions being provided. Providers have access to supraglottic airway devices that can be inserted rapidly and sealed around airway openings and to intubation adjuncts (e.g., bougie, video laryngoscopy) that aid in rapid intubation. Field personnel can now use colorimetry to verify airway placement or go a step further and monitor carbon dioxide levels (i.e., end-tidal CO\textsubscript{2} capnography), which can help verify accurate placement of an airway or the effectiveness of resuscitative efforts:
So, we set a metronome. We utilize impedance threshold devices (ITD) devices. We provide EZ-IO®s to obtain vascular access, somewhat of a luxury, although it shouldn't be . . . . We provide video laryngoscopes for difficult airways. We have trained our staff with bougie styles.

—EMS administrator, Site 3

Now, we carry an i-Gel® kit and then we have airway and suction capabilities, along with our own oxygen bottle. And then, for full arrests, every one of our apparatus is equipped with an FR3 [a new AED].

—Non-transporting fire staff, Site 2

In our study, participants looked favorably on most of these devices (Table 3.1) and felt that they contributed to positive outcomes, but clinical data of the efficacy of these interventions remains limited or conflicted, especially for mechanical CPR (Chiang et al., 2022), active compression-decompression and impedance threshold devices (Aufderheide et al., 2006; Nagele, 2011), and supraglottic airways and IO access (Benger et al., 2018; Hamam et al., 2021; Panchal et al., 2020). In addition, negative spillovers from their implementation have been highlighted. For example, mechanical CPR may provide consistent chest compression with less work on the part of the EMS provider, but experts have also raised concerns regarding CPR delays associated with placement and the consequences of device misplacement or migration (Johnson et al., 2022; Rowland et al., 2021; Wik, 2021).

Access to new devices and novel technologies thus gives prehospital providers more discretion and a larger toolbox to care for cardiac arrest patients, but such tools should not be viewed as panaceas. The addition of new devices to resuscitation workflows adds complexity and opportunities for failure. Therefore, in the absence of definitive clinical data on effectiveness of novel resuscitation adjuncts, it is perhaps most sensible to implement these devices in systems where the medical control physician has an up-to-date understanding of their pros and cons and also believes that the system training and oversight is sufficient for responders to consistently use these devices appropriately while avoiding their deadly pitfalls.
<table>
<thead>
<tr>
<th>Device</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Active decompression device (e.g., ResQPump)</td>
<td>A device with a suction cup on the end that allows a person performing chest compressions to apply force to the chest cavity both when pushing down and pulling up, thereby making both the compression and decompression motions in the movement “active.”</td>
</tr>
<tr>
<td>ITD (e.g., ResQPod)</td>
<td>A device that works in conjunction with an active decompression device to limit passive intake of air during the decompression phase. Limiting this air creates more space for blood to enter the heart during each decompression phase.</td>
</tr>
<tr>
<td>Real-time feedback device</td>
<td>A device that responders can use to measure the quality of their CPR in real time. This could be as simple as a metronome to assist with pacing or as advanced as a system that provides quantitative data on compression quality as they are being performed.</td>
</tr>
<tr>
<td>Mechanical CPR device (e.g., LUCAS, AutoPulse)</td>
<td>A machine that is designed to take over the work of providing chest compressions. It is secured to the patient’s torso and compresses their chest at a regular rate and depth.</td>
</tr>
<tr>
<td>BVM device (e.g., Ambu® resuscitator)</td>
<td>A device with a bag that contains air, a valve, and a mask that can seal to an OHCA patient’s face. Responders manually squeeze the back and force air into the lungs.</td>
</tr>
<tr>
<td>Supraglottic airways (i-Gel®, King Airway, Combitube)</td>
<td>Airway devices that secure the patient’s airway at the top of the patient’s windpipe, essentially creating a seal around the windpipe opening in the back of the throat.</td>
</tr>
<tr>
<td>Colorimetric carbon dioxide detector</td>
<td>A device used to verify the placement of invasive airways. The device changes color when exposed to the carbon dioxide present in exhaled breath. The device is placed between the airway and the BVM device to determine whether carbon dioxide is actually coming out of the tube. No carbon dioxide would indicate that the tube is in the esophagus or obstructed.</td>
</tr>
<tr>
<td>End-tidal carbon dioxide monitor</td>
<td>A device used by advanced EMS providers to provide a numeric measurement of the carbon dioxide being exhaled. Exhaled carbon dioxide is an important marker that can tell providers valuable information about the patient’s status.</td>
</tr>
<tr>
<td>IO drill (e.g., EZ-IO®)</td>
<td>A device for burrowing a catheter into a patient’s bone. The catheter can deliver medication via the bone marrow, which is ideal when IV access is a challenge because of low blood pressure (common in OHCA).</td>
</tr>
<tr>
<td>Cardiac monitor/defibrillator</td>
<td>A device used by advanced providers to manually monitor the electrical activity of the heart and deliver shocks to reset its rhythm is necessary.</td>
</tr>
<tr>
<td>AED</td>
<td>A device used by basic providers and lay persons to automatically assess the activity of the heart, determine whether a shock is needed, and deliver the shock. The user interface of these devices is simpler and easier to use but gives less information and less treatment flexibility.</td>
</tr>
<tr>
<td>Ventilator</td>
<td>A machine used to breath for the patient through positive pressure delivered via an endotracheal tube.</td>
</tr>
<tr>
<td>Intubation adjunct</td>
<td>A device designed to assist advanced providers in the intubation process, including bougie stylets and video laryngoscopes.</td>
</tr>
</tbody>
</table>
In addition to careful consideration regarding the devices implemented in the field, processes are needed to maintain and track equipment, and careful consideration should be given to how the equipment is set up on the responding units. Setup should facilitate rapid access and deployment of lifesaving equipment. Standardizing equipment setup across all emergency units can also ensure a rapid response regardless of the crew-vehicle configuration. One site’s police agency had a robust system for tracking and storing its AEDs:

I'll come in for my shift, I'll get our log, I'll check out whichever—and we'll have all the AEDs numbered 1 through, probably 1 through 4 or 1 through 6—but if I grab AED 1, I'm going to check it on our check-out list and then it goes out in the car with me. At the end of my shift, I bring that in, put it back in our roll call area, so that the next sergeant or patrolman, whoever it is, can check one of 'em out. So, that way, we've always got at least one person that has . . . well, every person on the road has one and they're not just sitting in a car not being used.

—Police and dispatch mid-level manager, Site 3

Another key informant mentioned that equipment that is commonly used together should be stored together:

Our first-in bag and our AED are on the other side, the driver’s side over there. In most of our engines, it's in the back of the apparatus, so that's someone's bunker gear, but right here you can see the AED and then the first-in bag. If you went to the fire engine right over there and go to the back compartment, you'd find the same thing. First-in bag and AED are always right next to each other.

—Non-EMS firefighter, Site 2

Furthermore, uniform setup of emergency vehicles minimizes impediments to patient care:

We are very specific on our inventory. All of our inventories are alike. On the ambulances, every single one of them are set up exactly the same, so there is no excuse to impede patient care.

—EMS executive administrator, Site 1

Providing the most-modern science-based equipment that is appropriate for your system competency level and maintaining and storing it effectively will contribute to the effectiveness of an emergency response system’s OHCA response. Cost can be a major barrier to equipping units with up-to-date technology, so systems might consider purchasing new equipment in phases,
outfitting units with the highest response volume first, and then outfitting less-active units during later purchases.

**Early Professional Response Sub-Phase**

In the *early professional response sub-phase* (Figure 3.5), the first wave of responders has arrived on scene. They focus on ensuring scene security, obtaining a basic story from bystanders, repositioning the patient to a workable space, providing high-quality CPR, securing the airway, and applying an AED. One of the most challenging aspects of this part of the response is balancing the priorities of scene safety and implementation of lifesaving efforts. Crews must find creative ways to ensure scene security and render lifesaving care simultaneously.

![Figure 3.5. Early Professional Response Sub-Phase](image)

**Early Professional Response Sub-Phase Strategies**

Strategies 14 and 15 cover the early professional response sub-phase:

14. Encourage aggressive CPR and AED intervention by the first emergency personnel on scene—including police and non-transport fire.
15. Early responders should keep dispatch updated on patient condition and resource needs.

**Strategy 14: Encourage Aggressive CPR and AED Intervention by the First Emergency Personnel on Scene—Including Police and Non-Transport Fire**

First-arriving personnel should immediately initiate high-quality CPR and quickly act to implement the third link in the cardiac arrest chain of survival: defibrillation. Considering that approximately 75 percent of cardiac arrests occur in private locations that are unlikely to have AEDs available (CARES, 2021), it is essential that the first arriving units have AED units and know how to operate them. The presence of responders equipped with AEDs has been shown to decrease the time required for defibrillation and improve outcomes in various communities (Husain and Eisenberg, 2013). This only works, however, if responders are intentional about the use of these interventions. A culture of hesitancy or reluctance to perform early interventions has been cited as a reason that some early responder programs fail to have a tangible effect on outcomes while others succeed (Groh et al., 2002). In many systems, the first emergency
personnel on scene for CPR and AED intervention is filled most effectively by law enforcement officers who are already deployed in their squad cars; however, because of the unique nature of emergency response systems, there might be someone in the system better suited to this role. A recent study conducted as part of the EPOC project found that the initiation of interventions by police or fire were associated with better OHCA outcomes (Salhi et al., 2022). System champions should consider their community’s public safety structures and availability of resources to determine what stakeholder is best positioned for this role. For example, police at one high-performing site are extremely excited about AED application while police at a middle performing site defer to EMS:

Saw the value in it . . . . Typically, our officers are arriving on scene before the fire department, so we wanted to have those tools in their hand. I think that’s another area I’ve talked to the fire chief on. He has an outlook on how long before an AED should be applied . . . before we just throw an AED on someone and working through that education component for our officers. Because now they’re at the point where I don’t know that I want them to come in the room with you guys. They’d probably try to throw an AED on all of you walking and talking because they’re excited about it.

—Police and dispatch administrator, Site 3

Furthermore, equipping law enforcement–based first responders with AEDs creates mobile AED deployment throughout an area. However, our research suggests that there is less enthusiasm among law enforcement in other communities:

And the police cars should all have AEDs because then it’s mobile. It’s a mobile station for those AEDs.

—Focus Group Participant, Site 7

First-responder (i.e., police and non-transport fire) AED programs have been successful throughout the world, although some experts argue that the programs might have greater value in suburban areas and rural areas where EMS response times might be longer (Heart Rescue Project, undated-b; McCoy, 2018). In high-performing systems, we found that first responders do not arrive on scene and wait for someone else to intervene; they are confident and proactive in performing their own defibrillation. System champions should be aware of the attitudes and practices among their own early responders.
Strategy 15: Early Responders Should Keep Dispatch Updated on Patient Condition and Resource Needs

As noted in our discussion of the pre-arrival phase, dispatch should provide updates regarding patient status to crews that are still en route to the scene. Dispatch cannot transmit that information if no one notifies them. Early professional responders have many tasks to complete and many considerations, but they must not forget that other responders are also en route. Early professional responders should air a notification that CPR is in progress and explain what additional resources they will need so dispatch can either communicate those needs to other responding units or responding units can receive the communication directly on a shared frequency:

What we do is, we will call the county dispatch over the radio when we confirm it’s a full arrest. If the dispatch on scene is any different from what we were originally dispatched to, we’ll ask them to tone it out again to let our people know that this isn’t an unresponsive person. This is a cardiac arrest and we need help, we need more people.

—Firefighter, Site 2

Full Resuscitation Team Sub-Phase

As more units arrive and the public safety response is more reflective of a full resuscitation team, additional roles are filled, leading to the full resuscitation team sub-phase (Figure 3.6). More in-depth medical history-taking occurs; crews begin planning the logistics of patient movement; mechanical CPR might be initiated; IV or IO access is obtained and drug delivery occurs; and end-tidal CO\(_2\) capnography (EtCO\(_2\); measurement of carbon dioxide levels in exhaled air) might be applied.

Figure 3.6. Full Resuscitation Team Sub-Phase

In a modern high-performing system, patients will receive high-quality CPR. Ventilations will be administered by a BVM at a rate and ratio corresponding to the airway that is placed. Advanced providers will have options available to them for administering drugs intravenously or
through the bone, and intubation will be facilitated by the use of such adjuncts as bougies or video laryngoscopy or deferred in favor of more rapid supraglottic airways. Patient status will be monitored by end-tidal capnography. High-performing systems also ensure that someone manages the logistics of the scene by taking a high-level view of the incident and that a sufficient number of qualified personnel arrive on scene. Finally, high-performance systems stay on scene and put in the work necessary to obtain ROSC, providing high-quality resuscitation in the field.

**Full Resuscitation Team Sub-Phase Strategies**

Strategies 16 through 20 address full resuscitation:

16. Appoint one responder to managing the logistics of the scene.
17. Track the resuscitation team’s work in real time using a formal checklist.
18. Deploy a sufficient number of qualified personnel to fill necessary roles on scene.
19. Send more than one advanced provider to the incident.
20. Stay on scene and do the work.

**Strategy 16: Appoint One Responder to Managing Logistics of the Scene**

OHCA incidents are complex emergencies that require the rapid coordination of numerous resources with different objectives and tasks. Because all these processes need to occur in a coordinated manner, it is important to designate one person—other than the EMS provider—to focus on the big picture and make sure that every resource is used effectively and no key task is forgotten:

> You need that facilitator on scene, and 99 percent of the time, it’s usually the person overseeing the monitor or the officer. That is the facilitator, basically, letting everyone know, okay, this is when we’re going to rotate, this is the time [to] check on this, this is making sure that you’re minimizing the pauses and so on and so forth.

—Focus group participant, Site 1

The responder in this role should not be carrying out focused tasks; they should be maintaining a high-level view of the situation. One informant compared OHCA with a small fire or small mass casualty incident:

> So, yeah, a cardiac arrest is a real small house fire, or a real small mass casualty, and it expands out from there to where the more things I add into it. As long as one person’s in charge and everybody’s doing their job, it’s fine.

—Fire-based EMS mid-level manager, Site 3

Another stated that too many hands on scene can lead to chaos:
There were multiple times where we would have six personnel from the fire department plus the additional two people from the ambulance. Sometimes a supervisor would show up because of the study, and we would have six to nine—six, seven, eight . . . we had eight to ten people on scene, and it was too much. It was way too much.

—Fire training officer, Site 3

High-performing systems have facilitators on scene who direct the resuscitation team and ensure that essential tasks are completed. The facilitator can direct people to take on predefined roles specified later in this section.

Strategy 17: Track the Resuscitation Team’s Work in Real Time Using a Formal Checklist

The appointed facilitator and others can use cognitive aids to assist in prioritizing objectives. Formal checklists have been suggested as one way to do this (also see Graham, McCoy, and Schultz, 2015):

I wish we had a formal checklist . . . but I’m not even sure you can apply a formal checklist to every . . . instance, but maybe even if we had a few specific things . . . maybe even an order of what did you see when you got there, what went well, what could we do better, and then is there anything that we can change for the outcome and go from there.

—EMS staff member, focus group, Site 2

One system that implemented team leaders (i.e., facilitators), checklists, formal roles, strategies for the assurance of high-quality CPR, and a debriefing program saw significant increases in their cardiac arrest survival rates (Nehme, Ball, et al., 2021). These checklists can then be used during the debriefing phase to assess team performance (Berg et al., 2020; Bouthillet, undated; ECG Medical Training, 2017).

Strategy 18: Deploy a Sufficient Number of Qualified Personnel to Fill Necessary Roles on Scene

OHCA emergencies are logistically complex and require a significant number of personnel to ensure that all tasks are completed appropriately:
But when you're in charge of nine guys in that kind of a situation, it can be a little overwhelming. Like I said, I don't think there's any data that proves that there's a diminishing return on having eight guys versus seven guys, but having at least seven guys on a cardiac arrest, it does make a difference. It's . . . jobs aren't getting missed. There's a lot of communication, there's a lot of, “Did we think about this?” That kind of stuff going on. And I think that's always beneficial.

—Fire-based EMS mid-level manager, Site 3

However, one stakeholder pointed out that it is not always feasible to send numerous personnel because of resource limitations:

So, we put nine on a cardiac arrest today because they're in the middle of a construction zone, and I didn't know if they're 100 yards from the road or in a parking lot, if we were going to have to carry the guy up and down hills and stuff like that. Do I think that putting seven on a cardiac arrest for every community is realistic? No, I don't. There's some communities that don't have seven period, like they don't even have that with their police.

—Fire-based EMS administrator, Site 3

The National Fire Protection Association (NFPA) recommends a minimum of four personnel on an ALS response (NFPA, 2020), but more can certainly be helpful. A recent publication found a significant increase in survival when more than seven responders were on scene (Lupton et al., 2021). A completely fleshed-out resuscitation team will have people in the roles listed in Table 3.2.
<table>
<thead>
<tr>
<th>Role</th>
<th>Minimum Qualification</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compressor</td>
<td>CPR training</td>
<td>Uses hands or manually activates compression-decompression device (e.g., ResQPump) to provide high-quality compressions, switching with another compressor every two minutes</td>
</tr>
<tr>
<td>Airway management</td>
<td>BLS training</td>
<td>Provides artificial ventilation with a BVM device; providers with advanced training might insert more advanced airways (e.g., i-Gel®, endotracheal intubation [ETI])</td>
</tr>
<tr>
<td>Mask seal</td>
<td>BLS Training</td>
<td>Uses both hands to maintain a mask seal when an advanced airway (i.e., supraglottic airway, ETI) is not in place</td>
</tr>
<tr>
<td>Mechanical CPR preparation</td>
<td>Training on mechanical CPR system</td>
<td>Prepares the mechanical CPR device for rapid placement and works in coordination with rest of team to rapidly place and activate the device</td>
</tr>
<tr>
<td>IV/IO access and drugs</td>
<td>ALS</td>
<td>Obtains access to the patient’s circulatory system via IV catheter or IO drill; administers medication as necessary</td>
</tr>
<tr>
<td>AED/monitor control</td>
<td>BLS (AED), ALS (Monitor)</td>
<td>Monitors patient status and manages shock delivery</td>
</tr>
<tr>
<td>Timekeeper/documentation</td>
<td>OHCA documentation training</td>
<td>Tracks timing of key events during the resuscitation (i.e., CPR initiation time, drug delivery times, shock delivery times)</td>
</tr>
<tr>
<td>Scene security</td>
<td>No resuscitation training needed</td>
<td>Monitors the scene for responder/patient safety concerns and mitigates them as needed</td>
</tr>
<tr>
<td>Family liaison</td>
<td>No resuscitation training needed</td>
<td>Speaks with the family, provides reassurance, answers questions, and obtains relevant information</td>
</tr>
<tr>
<td>History collection</td>
<td>History-taking training</td>
<td>Determines the patient’s medical history and what they were doing prior to the incident and gathers clues from the scene regarding what might have caused the cardiac arrest</td>
</tr>
<tr>
<td>Transport planning</td>
<td>No resuscitation training needed</td>
<td>Determines the best way to move the patient from their location to the ambulance and to reposition obstacles to facilitate this movement</td>
</tr>
<tr>
<td>Equipment management</td>
<td>No resuscitation training needed</td>
<td>Keeps track of the numerous medical bags and equipment on scene and monitors the battery levels of the mechanical CPR device and the oxygen levels in the O2 tank and switch things out as needed; ensures that battery chargers and spare batteries for mechanical CPR device are transferred to the hospital if the patient is transported</td>
</tr>
<tr>
<td>Attending provider</td>
<td>ALS</td>
<td>Takes charge of patient care and leads resuscitative efforts</td>
</tr>
<tr>
<td>Incident command</td>
<td>BLS, ALS preferred</td>
<td>Takes charge of personnel allocation and the logistics of the incident</td>
</tr>
</tbody>
</table>
To facilitate the adequate staffing of these roles, where feasible, systems should have staffing policies, mutual aid agreements, or multistakeholder response configurations that allow all these roles to be filled. A 2021 registry study found that having seven or more providers on scene significantly improves survival rates (Lupton et al., 2021). As noted earlier, there should also be a designated lead. That being said, these incidents are dynamic and require people to be flexible regarding the roles they fill:

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Everybody within our department knows their role, and they can assume different roles fluidly. So if I needed to go from compressions to now I’m giving . . . I’m on the bag giving breaths or respirations, or if I’m simply holding the IV bag for [EMS 1] or helping them out with anything, so it’s kind of a . . . everything just kind of sits here within the city.

—Public safety staff member, Site 2
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Few sites will have the resources to dispatch enough personnel to individually fill each of the roles depicted in Table 3.2. As a result, scene leadership is tasked with assigning one or multiple roles and responsibilities to others on scene. Therefore, it is also important that training programs familiarize responders with each function they might be assigned using the strategies discussed in Chapter 5 of this report.

**Strategy 19: Send More Than One Advanced Provider to the Incident**

Because some of the roles outlined here require an advanced provider (e.g., AEMT, paramedic, registered nurse, physician), having multiple advanced providers on scene allows these roles to be filled simultaneously:

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Here in [County 1] we’re blessed. Most of the time we’re staffed medic/medic. So that means that my paramedic partner, I know what they’re capable of. When I’m staffed with a basic, then they’re limited on what they’re allowed to do and that essentially doubles my role when I go on to cardiac arrests. Obviously, that’s going to slow down either their airway or it’s going to slow down IV access or it’s going to slow down their medications. So that’s a factor for us.

—Focus group participant, Site 0
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Again, we’re fortunate because of our staffing, where on this last call, there was one person driving and two paramedics in the back with the patient—the gentleman who was running the arrest and—actually, I lied . . . there were three of us in the back, so four total on the ambulance. So that gives us an opportunity that we’ve shifted and capitalized on since we are staffed this way.

—Fire-based EMS staff, Site 3

Additional advanced providers can also think more critically about the cause of the cardiac arrest and attempt to reverse it. For ALS units, the NFPA recommends having at least two ALS-level providers (NFPA, 2020). In several recent non-US studies the presence of a greater ratio of paramedic providers shows a relationship with improved outcomes (Sun et al., 2018), however we were unable to find recent studies using U.S. data. One 2010 study found no difference between two and three paramedics, but did not assess whether there was a difference between one and two (Eschmann et al., 2010). Systems might also consider deploying physicians to these emergencies, which has been associated with better outcomes (Goto, Funada, and Goto, 2019).

**Strategy 20: Stay on Scene and Do the Work**

The process of transporting a patient to the hospital is rife with opportunities to limit the quality of compressions. Whether it is better to rapidly transport cardiac arrest patients to a hospital or manage them in the field was long the subject of debate (Lo, 2020). However, several studies have found that transporting prior to ROSC is associated with lower survival rates (Jung et al., 2022), and that staying on scene for at least 30 minutes has shown improvements in survival (Berry et al., 2021; Eastin et al., 2019; Grunau et al., 2020). There is some suggestion that, for certain subsets of patients, intra-arrest transport to an ED with certain advanced therapies may be valuable, but there is no definitive evidence that supports this assertion (Belohlavek et al., 2022; Lupton, 2021; Nehme, Stub, and Smith, 2021). Thus, crews should not shy away from aggressively treating cardiac arrest in the field using all resources available.

In our review of sites, we found that higher-performing sites seem to have adopted this mindset. A key informant stated that the provision of care can be challenging in a moving ambulance:

We used just to yell and scream and kick, cannot work an arrest with two people, especially when we were transporting . . . Imagine that while someone’s doing 70 miles an hour down [Street 1] weaving in and out of traffic hitting bumps and stopping and you’re trying to stand and do compressions, give drugs, and call the hospital all at the same time.

—EMS mid-level manager, Site 4

At one high-performance site, they reported frequently having a physician on scene during OHCA, which might have made crews more comfortable staying on scene:
So, usually with a full arrest it’s ten, 15 minutes into it, we got a doc on scene, then you’re getting a different perspective and more capabilities—or sometimes two, depending on who they have on.

—Public safety officer, Site 2

In contrast, clinging to the “load and go” approach of the past was noted as a barrier to optimal care:

The advanced EMTs that we have are all 20- to 30-year guys, so they’re used to the treatment is oxygen and high-flow diesel, so they know, in their past, their experiences are oh, you just go there, you bundle them up and you take them to the hospital where everybody knows better, but I think that they’re starting to understand that what we do on scene is the same as what they do at the hospital, so they don’t fight us as much as they used to.

—EMS mid-level manager, Site 7

Studies have found that transporting prior to ROSC is associated with lower survival rates, and that staying on scene for at least 30 minutes has shown improvements in survival (Eastin et al., 2019; Grunau et al., 2020). There is some suggestion that, for certain subsets of patients, intra-arrest transport to an ED with certain advanced therapies might be valuable, but there is no definitive evidence that supports this assertion (Nehme, Stub, and Smith, 2021). One site reported staying on scene for ten minutes even after obtaining ROSC just to make sure the patient had stabilized:

So, what typically happens is [if] we load and go real fast . . . they re-arrest. Depending on where you’re located, you stop the ambulance, call dispatch and say, get the MFRs [medical first responders] here again. You might be in a different township, so basically all your resources are gone so you have to start over from square one again waiting for people to respond. So, instead, just wait on scene ten minutes with all your resources readily available and then if they don’t re-arrest within that ten minutes, they’re likely not to, get going to the hospital . . . and then in that case depending on how stable the patient is, they won’t go lights and sirens to the hospital.

—Non-EMS firefighter, Site 2

That being said, staying on scene might not always be the best choice for providers or for the patient, especially if there are scene safety concerns:
I think we’re fortunate with police and the firefighters are really good with dealing with family members but, in bad scenarios, like distraught family members can physically get in the way when you’re providing care and if they’re not, then you have them yelling at you and then it just kind of takes the focus off of the actual patient.

—EMS field staff, Site 2

Ultimately the decision to transport OHCA patients without ROSC requires consideration of numerous factors, but, in general, current limited data on North American EMS systems suggests that remaining on-scene and obtaining ROSC prior to transport may improve patient outcomes.

Transport Phase

The transport phase (Figure 3.7) begins when crews decide that it is time to transport the patient to the hospital. The patient must be moved from their position in the home, public, or facility onto an ambulance cot, transferred into the ambulance, and then driven to a receiving hospital. During this time, because of space limitations in the ambulance, the number of personnel able to attend to the patient is reduced. The EMS provider leading patient care usually notifies the hospital of the incoming patient and provides information regarding the case. The team must also continue to monitor the patient’s status and provide appropriate care. In some cases, an additional transfer between a BLS or limited ALS (LALS) ambulance and an ALS ambulance might take place prior to arrival at the hospital. This is referred to as an ALS intercept.

![Figure 3.7. Transport Phase](image)

In high-performing systems, ALS ambulances provide the initial transport or arrangements for an ALS intercept occur when appropriate (i.e., an ALS unit meets the transporting unit on the way to the hospital). Transporting crews use modern technologies to facilitate transport, including placing patients with inadequate breathing on ventilators and transporting with a mechanical CPR device in place to facilitate compression delivery if the patient re-arrests in the back of the cab. The crew will provide sufficient information to the receiving hospital so that ED
staff can prepare for necessary care; telecommunication technology might be used to share this information more effectively. Finally, high-performing systems will have designated centers that patients with ROSC should be transported to.

**Transport Phase Strategy**

Strategies 21 through 24 address transport phase recommendations:

21. Leverage other first responders to drive the ambulance so that multiple EMS personnel can work together in the patient compartment.
22. Transport OHCA patients using ALS units or arrange to meet an ALS unit on the way to the hospital.
23. Consider use of ventilators and mechanical CPR devices to offset ambulance space limitations if necessary.
24. Communicate patient information to the receiving hospital in a meaningful way.

**Strategy 21: Leverage Other First Responders to Drive the Ambulance So Multiple EMS Personnel Can Work Together in the Patient Compartment**

There are numerous patient care tasks that need to be completed en route to the hospital, such as monitoring the patient’s status, arming life threatening arrhythmia alarms, administering medication, making radio reports, and providing manual or mechanical ventilation. If, for whatever reason, a patient who is in active cardiac arrest is transported or if a recurrent cardiac arrest occurs during transport, chest compressions must also be in progress. These tasks are difficult for a single individual to manage and can be more adequately performed by multiple responders. In these instances, first responders and EMS personnel who normally would not be part of the transporting crew can assist either by riding in the back and assisting with patient care or, if both members of the ambulance crew have more-advanced medical training, by driving the ambulance. According to a Fire Administrator on a site visit, fire personnel can act as drivers for viable OHCA patients:

> I mean, we also provide drivers for them if the patient is viable.
> —Non-transport fire administrator, Site 3

**Strategy 22: Transport OHCA Patients Using ALS units or Arrange to Meet ALS Units on the Way to the Hospital**

In remote communities with long travel distance to hospitals, systems without ALS staffing (or with sparse staffing) might consider conducting an ALS intercept, in which a post-ROSC patient being transported by a BLS or LALS provider is met by an ALS crew en route to the hospital:
[EMS Agency 1] is an advanced life support agency and some of the surrounding smaller communities can’t afford that, okay? So, they have basic life support units in surrounding communities. What [EMS Agency 1] does is they offer a paramedic with the drugs, the cardiac monitors and that type of thing to respond with or, like, catch up with, meet up, rendezvous with the basic agency that actually has a patient in cardiac arrest or potentially chest pain.

—EMS leadership, Site 6

The ALS provider will bring more-advanced equipment from their unit into the unit taking care of the patient and lead the remaining patient care until arrival at the hospital. During this process, communication between providers is key so that treatments are guided by the most accurate information.

Strategy 23: Consider Use of Ventilators and Mechanical CPR Devices to Offset Ambulance Space Limitations if Necessary

During transport, the use of mechanical CPR devices and ventilators can help perform tasks made difficult by the mobility of the unit and the limited number of personnel who can fit in the back of an ambulance. Maintaining a mechanical CPR device on the patient allows compressions to be rapidly initiated in the event of a re-arrest, and the use of a ventilator by trained staff frees up a pair of hands for other tasks. Although these tasks are managed by machines, EMS providers can remain secured by their seatbelts and are able to perform other essential functions during the transport phase, such as patient assessment and hospital notification. A key informant highlighted the benefits of a LUCAS device (a machine that is secured to the patient’s torso and compresses their chest at a regular rate and depth) for high-quality CPR among smaller crews:

That’s part of another reason with the LUCAS and, like, with the vent. We run two-person crews, so once we get them on the LUCAS [and] I get them intubated and on the ventilator, it’s a whole lot easier. So, we’re maintaining good, quality CPR and ventilations with only two people.

—EMS mid-level manager, Site 5

That being said, mechanical devices here are subject to the same limitations as they are on scene, requiring training and oversight. Of course, the benefits of these devices should be established in large-scale clinical trials, but their benefit in simplifying care processes in ambulances was noted through interviews.

It should be noted that ventilators and mechanical CPR devices must have the same maintenance policies and procedures to ensure their proper function as the other clinical equipment previously mentioned.
Strategy 24: Communicate Patient Information to the Receiving Hospital in a Meaningful Way

While en route, it is important that EMS provides the receiving ED with adequate information to prepare for the incoming patient. Resources in the ED and catheterization (cath) lab need to be activated so that appropriate care can begin immediately on patient arrival. When patient information is communicated through a radio report, it can help the hospital prepare and set up the cath lab in the case of suspected ST-elevation myocardial infarction as a cause of the OHCA:

On the way there, we completed a 12-lead that showed ST-segment-elevation in V2, V3, and V4, and that was conveyed on the radio report to get the cath lab moving, and so . . . before we had cleared the hospital after-care transfer, he was already on his way up to the cath lab. So I certainly felt that it went pretty well as far as what your end game and goal should be.

—Focus group participant, Site 3

According to a key informant, nurses were required to have training in use of the EMS radio, and this training improved communication:

We started training all the nurses that answer the radio. You cannot touch the radio until you've gone through training. The communication between EMS and our hospital improved.

—Focus group participant, Site 1

Some EMS systems have implemented telecommunication technologies (e.g., field-ECG transmission) that allow for information transfer beyond radio reports. These include such systems as Pulsara®, Twiage® and e-Bridge®. One key informant noted that heart monitors used by the fire department transmit data directly to the cardiac team at the hospital:

I told you about heart monitors that were donated from the hospital. They have the ability to transmit to the cardiac team right at the hospital, so they know what we're bringing in before we even leave the house.

—Fire leadership, Site 7

Implementation of these technologies will be most effective if all EMS agencies in the community and hospital systems decide to use the same systems and collaborate on their implementation, thus reducing the possibility of delays and missed handoffs stemming from interoperability issues.
Handoff Phase

The *handoff phase* (Figure 3.8) takes place at the hospital, where the prehospital care team passes patient care to the ED team. The prehospital team will move the patient to the treatment room and work with the ED team to physically move the patient from the ambulance cot to the hospital bed. The attending EMS provider will give a verbal report to the hospital team regarding the incident and the care provided.

![Figure 3.8. Handoff Phase](image)

This phase can be an especially challenging moment in the sequence of care for a cardiac arrest patient because it represents a transition between two distinct professional cultures and worksites. Communication and teamwork gaps might occur because of these differences (Meisel et al., 2015). Additionally, EMS providers might have a limited time to present information to ED staff, who are simultaneously managing other patients (Appelbaum et al., 2021). However, small details here, especially for critical OHCA patients, can make big differences in the patient’s course of care (ESO Staff, 2020). Some EMTs and paramedics even view the handoff phase as a “golden minute” to have a meaningful influence on the care that the patient will receive at the hospital (Meisel et al., 2015). A key informant described a handoff in which hospital ED staff were prepared to take over patient care from EMS:

> And by then, the hospital staff . . . I mean, they see what’s going on as soon as we get there. So, if we’re wheeling in, we’re providing respirations and somebody else is doing compressions, obviously they see that. That team of eight people, ten people, is right there and we’re wheeling up and there’s always somebody ready to take the bag or somebody ready to start compressions.

—Firefighter, Site 1

Handoff can be a stressful moment in the sequence of care as hospital staff and prehospital staff work to transfer equipment, and the EMS provider recalls the patient’s history, the events leading up to their current state, the treatments, and reactions of the patient up to that point, and
other key details. The stress at this key juncture can be detrimental to information-sharing (Lum and Halse, 2017).

**Handoff Phase Strategy**

In the interest of streamlining and optimizing this phase in patient care, we propose the following two strategies:

25. Provide structured handoffs in an efficient, standardized manner.
26. Facilitate active engagement of all participants in the handoff.

**Strategy 25: Provide Structured Handoffs in an Efficient, Standardized Manner**

One opportunity to improve handoff practices, mitigate information loss, and optimize handoff efficiency is to implement a standardized handoff system (Maddry, Simon, et al., 2021; Meisel et al., 2015). Having a common structure for information-sharing can help ensure that information is not lost because of distraction or other reasons. If a distraction occurs and an EMS provider has to interrupt their report briefly, having a standard process allows them to return to where they left off, thereby ensuring complete information transfer (Moreira and French, 2019). Standardized information reporting can also lead to faster handoffs that contain more information (Lum and Halse, 2017). Standardized handoffs should consist of both written and verbal information (Tews, undated), including the results of any prehospital tests or exams (American College of Emergency Physicians et al., 2014). Unfortunately, written information is not always a part of the process and might not even be available when physicians begin to provide treatment (Shelton and Sinclair, 2016; Yong, Dent, and Weiland, 2008). With that understanding, it is still important to recognize that handoff processes need some flexibility, as rigid protocols might not capture every detail for each patient and unique arrest scenario (Reay et al., 2020). A focus group participant described a “one-minute rule” that was used to reduce the time needed for EMS to complete their report to hospital personnel. This helps EMS and hospital staff respect each other’s time and increases the efficiency of the information exchange:

> I mean, there’s the other end of it, too, where we have some people in EMS that wanna give a five-minute dissertation on everything and we don’t have time for that. If we can keep it down to one minute and the nurses and doctors will give us one minute, then I think everything goes well.

—EMS staff, Site 2

Implementation of a standardized handoff process requires additional training on the process for EMS. Such training might be beneficial even without a standardized process; EMS personnel reported in previous studies that they lack training on handoffs (Javidan et al., 2020). Two models that systems might want to consider are the “SBAR+2” model and the MIST model.
(Maddry, Arana, et al., 2021; Tews, undated). Others have suggested the use of a checklist, spreadsheet, or other standardized document to aid in this process (Appelbaum et al., 2021). To ensure that the process meets the needs of both stakeholder groups, both ED and EMS representatives should be involved in planning any standard practice implementation.

**Strategy 26: Facilitate Active Engagement of All Participants in the Handoff**

A common concern of EMS personnel is that ED staff, who must simultaneously perform their own work, are not absorbing the details of the EMS report (Duckworth, 2016; Shelton and Sinclair, 2016). Steps should be taken to ensure that these details are captured by the ED so that important information is not lost in the care transition. Some strategies to ensure information capture are appointing an ED-EMS liaison who focuses only on taking reports while the rest of the ED staff perform needed tasks (Troyer and Brady, 2020); fostering a culture of respect and collaboration among ED and EMS staff (Brooks, Friedrichsen, and Nalin, 2021); and maintaining a quiet environment in which the information transfer can take place (Bucher and Zaidi, 2016). As expressed by key informants and embodied by the one-minute rule already described, the medic needs to communicate to nurses and doctors at the hospital during the handoff. Some ED physicians might quiet the room to ensure the medic is able to share a full patient status report. A key informant reported that an EMT went into the ED to give the report while the patient was being unloaded as a way to eliminate the distraction of having the patient there:

> There's some physicians, especially prior EMS physicians, if they were medics earlier in their career or EMTs, we'll go in there, in the recess bays at the University 1 or Hospital 1, and they will tell everyone, “be quiet,” and they will make eye contact with the medic and, “I need to hear this,” and they listen.

—EMT, Pilot Site 0

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3 SBAR+2 is a standard handoff format adapted for health care that suggests reports be given in the following format: provider introduction, situation description, background information, assessment, and recommendation, with an opportunity for a question-and-answer session at the end. MIST is a tool specifically designed for the prehospital-to-hospital exchange of information and calls for reporting of mechanism of injury or medical complaint, injuries or head-to-toe inspections, vital signs, and treatments.
Debriefing Phase

In the *debriefing phase*,prehospital personnel take time to reflect on a particular case. This can take many forms, which vary across systems. At the very least, the attending EMS provider will document the care that was provided for the patient. In some cases, the team that remains on scene will have a brief conversation about the case or will have a more formal discussion of the event in the following days. Some systems will even pull data from AEDs to review audio and waveform recordings. This phase should be seen as the incident-level quality improvement process (Figure 3.9) but should not stand alone. It should be interconnected with both stakeholder- and system-level quality improvement processes that are discussed later in this report.

**Figure 3.9. Quality Improvement Processes at Every Level**

**Debriefing Phase Strategies**

Strategies 27 and 28 address the debriefing phase:

27. Conduct a debriefing after a cardiac arrest event.
28. Collect information from various sources (i.e., AED recordings, body camera recordings, documentation) and generate reports on all cardiac arrest incidents for quality improvement purposes.

Strategy 27: Conduct a Debriefing After a Cardiac Arrest Event

Systems should aim to implement a multidisciplinary debriefing process following a resuscitation event in which the involved responders have a chance to discuss the events of the cardiac arrest, areas where the team performed well, and any areas for improvement. These debriefs might be hot (i.e., immediately after the cardiac arrest event) or cold (i.e., at a later time) (Kronick et al., 2015). Debriefs have been associated with improved CPR quality and team performance (Berg et al., 2020; Graham, McCoy, and Schultz, 2015).

Cold debriefing might present logistical challenges because it can be difficult to get all responders in the same place. However, the recent migration of life and work meetings to video teleconference software in relation to the COVID-19 pandemic might present an opportunity for these debriefings to be more commonplace (Cheng et al., 2018; Cheng, Kolbe, et al., 2020; Stafford et al., 2021). In the EPOC study, one site conducted hot debriefings, and another implemented a mixture of informal hot and formal cold debriefings for critical resuscitation incidents:

> There’s usually a little bit of downtime either directly after the arrest on scene or potentially at the hospital if we’ve transported . . . . We try to take a minute and to keep as many of the parties as possible around to do a little bit of a hot wash just immediately, immediate incident debrief and talk about what went well, what can we do better for the next time . . . . I think everybody here has the desire to improve.

> —EMS staff, Site 2

Another site suggested that findings from one crew’s debriefing process be shared across shifts and that debriefing should occur in phases. They noted that debriefing should not be able reprimand, but about improvement. The next step, before sharing across shifts, is that the crew that was working should break down the incident together:

> Any type of debrief that you do, it has to be nonpunitive . . . it can’t be about assigning blame. It has to be with the goal of improving.

> —Fire-based EMS mid-level manager, Site 3

Finally, after that initial debriefing session, other crews that were not involved but who might learn from the incident can be presented with the information gleaned from the debriefing process:
Then [the Chief] will then go and bring those findings across the other two shifts too . . . . Here’s the stuff that went well. Here’s a couple things that need improvement. Let’s talk about it . . . . Just because the other two shifts didn’t have this arrest, they’re [still] going to learn about it and hear about it . . . . [Like,] they were outside at a construction site and this guy was cold and he had three layers of Carhartts . . . these were some obstacles . . . be prepared for them, etc."

—Fire-based EMS field staff, Site 3

Post-incident debriefs might also be facilitated by responding EMS physicians as an opportunity for field crews to receive medical feedback on a real-life case.

Strategy 28: Collect and Share Information from Various Sources (i.e., AED Recordings, Body Camera Recordings, Documentation) and Generate Reports on All Cardiac Arrest Incidents for Quality Improvement Purposes

Systems should also consider reviewing incident-level data from the various available sources, such as AEDs, manual defibrillators, body- or ambulance-mounted cameras, 911 recordings, and electronic patient care reports (Bak et al., 2021; Dewar et al., 2019; Hansen and Nielsen, 2014; Homma et al., 2020; Jones et al., 2017). The recordings can be used for quality improvement efforts. One community has an integrated quality improvement program and plans to upgrade their monitors with cloud-based features, enabling real-time feedback with the EMS crew. Several sites brought up the use of AED or monitor data in quality improvement efforts:

Most of the AEDs on the market . . . actually get a fair amount of information, but almost nobody has a process in place to pull that information off that AED and share it with the responders because you can get . . . initial rhythms, you get all of this stuff, but a lot of people don’t take advantage of that.

—EMS champion, Site 4

There will ultimately be a more formal thing where the chief will look at the event and the rhythm and make sure that, obviously, there’s evidence that we stayed on the chest . . . and then he’ll come back to us, like, “Hey, all these things went great. Nice job.” Or, “Hey you guys, I noticed this. Tell me why it took three minutes to get end-tidal monitoring on? I want—we want—the end-tidal to be on the BVM with the first breath with an OPA. Why did it take two minutes?”

—Fire-based EMS field staff, Site 3

Another site mentioned the implementation of video review as a useful future direction:
It would be nice to . . . what they want to do is maybe, say they record it in a YouTube video and then you can sit down in a conference room with the team that was there and review . . . . I know it’s a work in progress but because of all the proprietary limitations, I know it’s been challenging, so that would be nice.

—EMS staff member, focus group, Site2

These data should also be used for broader stakeholder-level and system-level quality improvement efforts.

Incident-Level Conclusions

OHCA emergencies are extremely complex events that require numerous stakeholders to work together seamlessly. In this chapter, we reviewed the key events that must occur at the incident level during an individual cardiac arrest and discussed strategies to optimize the care that these patients receive in the field. In the next chapter, we will discuss each component of the system of care—the gears in the cardiac arrest management machine, the players of the cardiac arrest response team—and how to make them individually better.
Chapter 4. Part 2: Stakeholder-Level—Optimizing Each System Component

Introduction

The integral components of the OHCA system of care can be broadly classified into two major groups: the community components and the public safety stakeholder components. The community components consist of the community members who are responsible for noticing emergencies, activating the emergency response system, and intervening before professional help arrives. Their performance is defined by community education and willingness and ability to intervene. The public safety stakeholder components consist of the individual public safety agencies who respond to cardiac arrest emergencies. In this chapter, we talk more about these components and discuss ways to optimize them, similar to the way a mechanic would oil a car to keep it running well. Ensuring that each component of the emergency response system of care is in optimal condition ensures that OHCA emergencies occur in a more favorable context, thereby improving the chance of an optimal outcome.

Community Factors

The community plays an undeniably important role in response to OHCA emergencies. Without their rapid recognition of emergency conditions and activation of the emergency response system, help might never get to the patient. Additionally, the actions of community members during the activation and pre-arrival phases often have the greatest impact on the outcome of cardiac arrest (Deakin, 2018). There are several things emergency response systems can do to improve community understanding of and preparedness for an OHCA emergency.

Strategies to Enhance Community Response in Emergency Response Systems

Strategies 29 and 30 address the community response in emergency response systems:

29. Implement community education programs on cardiac arrest recognition, performing CPR, and AED application.
30. Invest in public access AED programs.

Strategy 29: Implement Community Education Programs on Cardiac Arrest Recognition, Performing CPR, and AED Application

Community education programs aim to enhance public preparedness for cardiac arrest emergencies and increase bystander readiness and willingness to act when necessary. Better-informed communities provide a better context for an institutional response (i.e., structured public safety response) and are likely to result in better outcomes for OHCA victims.
Community education programs can be implemented by any stakeholder in the OHCA response system, or stakeholders might consolidate their efforts to create a multidisciplinary community education team. In this section, we will explore various community education targets, facilitators, messaging strategies, and methods.

**Program Design**

The first factor in a community education program is to consider who is the target of information. Options include students at schools or universities (Applegate et al., 2015; Blewer et al., 2020; Graham, McCoy, and Schultz, 2015; Heart Rescue Project, undated-b; McCoy, 2018), high-risk populations (Heart Rescue Project, undated-b), underserved populations (Cheng, Magid, et al., 2020), the general public (Adelborg et al., 2011), employees at local businesses (Heart Rescue Project, undated-b), university professors (Kappus and McCullough, 2020), and governmental employees. The target audience should determine the tone and style of educational messaging. One site provides CPR courses to all high school students in their community and has used the program as an opportunity to develop relationships with the schools:

We also provide CPR education to the entire high school population in [City 2]. So, that was an unfunded state mandate a few years ago . . . . We took that opportunity to say hey, we will provide CPR education to your students and expand our relationship with the schools, and now we basically provide CPR education in health class; it’s a mandatory requirement for graduation . . . . Ultimately, we’ll have generations and generations of people who are educated in CPR, they can perform CPR prior to arrival . . . . outcomes will improve.

— Fire-based EMS champion, Site 3

Teaching the skills of CPR and AED application are a common feature of such programs. Simple messaging can be used (Heart Rescue Project, undated-b) to explain what to expect when calling 911 (Minnesota Office of the Legislative Auditor, Program Evaluation Division, undated; Shneiderman and Preece, 2007); cardiovascular warnings signs, signs of cardiac arrest, and commonly confused conditions (Brady, Mattu, and Slovis, 2019; Newman et al., 2016; Rao and Kern, 2018); and legal protections for lay responders (Heart Rescue Project, undated-b; Murphy et al., 2020). Although teaching advanced resuscitation skills to a certain subset of bystanders might be useful, many systems have opted to keep training simple and focus primarily on hands-only CPR (i.e., chest compressions only) as a more efficient community education strategy (Hooker and Werft, 2021; Rao and Kern, 2018). A community education initiative focuses on how to use 911 and other topics related to emergency response and management:
Part of the presentations I give is . . . how to access 911. What does 911 need or what happens when they’re accessing the system? . . . And so, then we go from there into recognition of stroke and cardiovascular disease symptoms . . . that it’s a multiphase process where [Staff 2] actually taking the phone call but I’m actually sending the unit at the same time . . . . Camp 911, we use it for the younger crowd, so that’s between ages 8 and 11. And again, the same process but just at a more appropriate age limit. We do cover things also with fire safety, helmet safety, police safety, CPR, trauma, first aid for them [too].

—Dispatch staff, Site 2

When I do my HeartSaver courses . . . when I go over the AED, I don’t show how to plug it on purpose . . . . So . . . when we’re practicing, I go, “okay now what do we gotta do?” . . . Open it up and . . . turn it on and they see the pads, like, “where are you going to plug the pads in?” and they’re like, “I don’t know!” I’m like, “look . . . that’s going to happen when they’re really on the street” . . . . So that way . . . .[they have] that moment of panic in class . . . . Those are some of the tricks that we use.

—Fire-based EMS mid-level manager, Site 4

Training can occur in a variety of locations, such as Department of Motor Vehicles or Secretary of State offices, schools, religious communities, outpatient clinics, sporting events (Yancey, 2015), sidewalk tables (Jain, 2016), university classrooms (Kappus and McCullough, 2020), community events, workplaces, or online. It could be self-directed (Aldeen et al., 2013) or delivered via an array of formats, such as the traditional classroom setting (Graham, McCoy, and Schultz, 2015), community kiosk (Heard et al., 2019), mass training (Heart Rescue Project, undated-b), virtual reality (Semeraro et al., 2017), and train-the-trainer sessions (Hooker and Werft, 2021). For example, CPR courses were conducted by the fire department at a local church:

What we had is one of the local churches bought an AED and they wanted training, so we just made it a friends and family class and most of the students were elderly people.

—Non-transporting firefighter, focus group, Site 5

Non-self-directed training can be delivered by a variety of individuals, such as community volunteers, 911 telecommunicators, firefighters, police officers, EMS personnel, teachers, and
professors. For instance, a fire department created its own community education curriculum specifically for high school classes prior to even reaching out to the school:

We created our own curriculum, and we did that to prevent barriers, specifically working with the schools, so rather than just asking, “hey, do you want us to do CPR classes,” we took it upon ourselves to design a curriculum and say, “how do you feel about us implementing this curriculum in your school?”

—Fire-based EMS champion, Site 3

One stakeholder group could manage this for the community, or stakeholders could consider cost-sharing and pooling resources to make more-robust and more-comprehensive training programs available. Another important consideration is how to sustain the program over the long term. Will community stakeholders be willing to support the program financially? Several sites noted that the cost of CPR training is a significant barrier to community engagement. Therefore, any direct costs to community members should be weighed with the community’s reasonable ability to pay. The program designer must also consider the benchmarks that other funders would want to see for them to be willing to contribute, and whether training resources would be used efficiently under their plan. One site noted that, despite investing time and energy into training staff on OHCA response at a local skilled nursing facility, turnover rates undermined that program:

So, I can meet with an executive director of an assisted living, I can provide CPR training to all their workers, and—truly—a week later, it could be 100 percent different, like 100 percent staff turnover.

—Fire-based EMS administrator, Site 3

Program design is as varied as the emergency response systems across the country. Therefore, it falls to system planners and OHCA champions to determine what mechanisms of education will be most effective in their communities.

**Media Campaigns**

Community education should also extend beyond structured classes and training programs. System champions should levy messaging campaigns that use both traditional and social media (also see Heart Rescue Project, undated-b):
And so, I think public awareness of that through public service ads would be the best way, and I would be very blunt, “do you know what to do, call 911, apply the AED, start compressions?”

—Medical director, Site 7

Some systems have implemented multipronged approaches to community education, such as in British Columbia, where they used TV, print, radio, billboards, and the web for eight weeks to inform the community about the work of the emergency response system (“British Columbia Paramedics Launch Major Public Awareness Campaign,” 2015). Similar strategies might be implemented for cardiac arrest awareness.

The added use of social media allows system champions and OHCA response advocates to reach a large number of community members, especially younger ones, and can foster better relationships between the community and the emergency response system (Engel, 2020).

For these campaigns to take effect, it is recommended that system champions try to develop media relationships and a social media strategy that can be used to affect other community messaging initiatives down the line (Fire and Emergency Service Image Task Force, 2013).

Strategy 30: Invest in Public Access AED Programs

Another way to strengthen community preparedness is through investment in public access defibrillation programs. Treatment for OHCA victims with a bystander AED confers survival rates as high as 40 percent (Bækgaard et al., 2017). Strategic placement of AEDs in areas where they will be of most use has been advocated both in the literature and by the participants. For example, a paramedic advocates the placement of additional AEDs and consideration of legal mandates for their distribution in populous areas:

You know, the first thing that pops into my head is more public AEDs . . . . I appreciate that AEDs are money and I understand those obstacles, but if there’s a legislative way that . . . if you have a business complex, like a strip mall . . . one of them, or the most central one should have [an AED] . . . . The more AEDs the better.

—Fire-based EMS field staff, Site 3

Studies have suggested that widespread deployment of static AEDs might not be a cost-effective intervention, but strategic positioning in high-volume, high-traffic, or hard-to-access areas might be a valuable community-level intervention (Graham, McCoy, and Schultz, 2015; Moran et al., 2015; Rao and Kern, 2018). More specific criteria include selecting a site where more than 250 adults over the age of 50 are accessing the location more than 16 hours per day, the presence of high-risk individuals or a high-risk location, health clubs with more than 2,500 members, and a cardiac arrest event at the location at least once every few years (Graham,
McCoy, and Schultz, 2015). Examples of these advantageous locations include casinos, transport systems (e.g., trains, airplanes), and sporting venues (Rao and Kern, 2018). Although these programs do confer benefits, any organization implementing a public access defibrillation program must ensure that they have a maintenance plan to replace expired pads and ensure that the battery remains charged.

**Community Factors Conclusions**

The community is a key resource for and key component of an adequate response for cardiac arrest. System champions should leverage multipronged approaches to improve community knowledge and engagement in the OHCA response. Additionally, they should consider community organizations that might serve as valuable contributors to long-term system improvement efforts.

**Public Safety Factors**

The next major category of system components involves the public safety organizations that make up the professional response chain of care. All it takes is one component member of the system to fail for the system to function poorly or not work at all. It is important that each component of the system is refined and well managed. As mentioned before, the exact configuration of these stakeholders varies widely across systems. The following sections will focus on ways to optimize the role of key stakeholders across four key domains:

- professional responder training
- material resources
- organizational culture
- quality improvement processes.

**Professional Responder Training**

Professional responder training refers to the general training of all institutional members of the chain of survival: dispatch, police, fire, EMS, etc.

**Professional Responder Training Strategies**

The following general professional training strategies are applicable to all disciplines:

31. Create a standardized training program for each stakeholder that is tailored to their specific role.
32. Ensure that recurrent training occurs on OHCA topics.
33. Consider cross-training responders in multiple roles.
Strategy 31: Create a Standardized Training Program for Each Stakeholder That Is Tailored to Their Specific Role

The initial resuscitation training of professional emergency responders plays a key role in effective implementation of high-priority interventions across the emergency response phases and the chain of survival. Emergency responders must have the knowledge and skills to effectively recognize the OHCA emergency and skillfully intervene according to their role in the system of care. For telecommunicators, this means having the skills to coach a caller through CPR over the phone; for first responders, it means training on high-quality CPR and the many other interventions recommended in the earlier part of this report. Finally, for advanced providers, it means understanding both the fundamentals and the advanced skills involved in resuscitation. Initial training programs must provide the basic content knowledge and allow trainees to practice applying the principles and approaches using simulation and high-quality training materials. For this strategy, we will break down the specifics of emergency response training programs that should cover and discuss general best practices in the initial teaching of resuscitation to emergency responders of all disciplines: emergency telecommunicators, first responders with basic training, and advanced transporting providers.

**Telecommunicators**

The AHA recommends that initial telecommunicator resuscitation training be at least three to four hours and focus on such topics as anatomy, physiology, and pathophysiology of cardiac arrest; recognition of acute coronary syndrome and OHCA; conditions that complicate life assessments (i.e., hypoxic seizure, agonal breathing); and the role that telecommunicator (i.e., dispatch-instructed) CPR plays in improving survival, minimizing time-off chest, and AED use (Kurz et al., 2020). The AHA and the national EMS office also advocate discussing special circumstances, such as infant and pediatric cardiac arrest and those related to overdose, environmental emergencies, and strangulation (National Highway Traffic Safety Administration, undated-b). One telecommunicator notes the key words they look for when screening for agonal breathing:

> Snoring; a lot of it’s sound. I use snoring, bubbles, humming . . . . That usually triggers for me. There isn’t one that I go to. I just start with one and I keep going down the list of terms until one clicks with the caller. Or I’ll get the phone close enough.

> —Dispatch field staff interview, Site 3

Telecommunicator training should also teach crisis communication skills so that telecommunicators can leverage this knowledge by coaching bystanders. Telecommunicators should learn to express urgency and inevitability in their directives rather than making requests (Riou, Ball, Whiteside, et al., 2018). Additionally, they should be prepared for callers who will
not follow their directives or give them more information than they are prepared for (Riou, Ball, O’Halloran, et al., 2018). For example, one site described how their telecommunicators might receive special training on crisis communication:

We educate our staff on how to manipulate somebody in crisis, to get them to be compliant. And so, doing things like dropping your tone of voice and quieting down, a bit softening it down, where then people start to tune in, versus just losing control, screaming—that’s the job of the EMD, is to regain that access.

—Dispatch administrator, Site 2

Telecommunicators might also need to be trained on the specific dispatching system that their agency uses. For example, dispatchers using MPDS require training as EMDs.

**BLS First Responders (e.g., Police, Non-Transporting Fire)**

First responders who provide a BLS level of care need training in high-quality CPR but must be given the opportunity to practice these skills in the context of the full system of care. Practice must encompass all aspects of the process in which the first responder might be involved; not just clinical care but also scene management, scene communication, and bystander interaction. Additionally, systems should consider providing the standard ACLS training to their BLS providers irrespective of their ability to perform ALS interventions—the AHA has recommended that “all healthcare professionals likely to participate in the care of adult cardiac arrest patients take the ACLS course or equivalent training” (Cheng, Magid, et al., 2020).

**Advanced EMS Providers (e.g., ALS Transporting and Non-Transporting Units)**

Advanced EMS providers on scene who are trained in ALS interventions must be trained to think beyond protocols and consider the context of the situation. Although this is also true for basic providers, this strategy applies especially to advanced providers, who will often be seen as the leader of cardiac arrest. Advanced providers must have all the training and skills of BLS responders but be equipped with the knowledge and skills to implement the tools they have at their disposal to treat the reversible causes of cardiac arrest.

**All Responder Groups**

All responder groups need familiarity with the principles of high-quality CPR as outlined in earlier strategies. Dispatch needs to know how to coach the provision of high-quality CPR by bystanders, and CPR needs to be implemented throughout the course of the on-scene phase until the patient has a pulse again. A stakeholder noted that the quality of compression is key to a high-performing system:
I just think that there wasn’t the understanding of how critical the compression portion is and how it’s not just put the weakest link on that task and don’t worry about it anymore. You know, that’s critically important . . . so it might not be policy, but it became like a practice thing, Okay, you’re resting on the chest. I need you to come on and get your knees on the patient’s side—all those tiny little things that mean the difference.

—Fire-based EMS field staff, Site 3

All responder groups need to practice the skills they learn prior to applying them to a real patient. The implementation of simulation or scenario-based training permits the consolidation of knowledge and skills in a practical way. It is the “next best thing” to practicing care on real patients but has the added benefit of being low acuity and relatively risk-free. A key informant highlighted simulation as an important tool for training:

It’s still a simulation, but it’s the next best thing. It’s the closest thing we’ve got to real patients.

—EMS administrator, Site 6

Another stated that a scenario-based program is more engaging and enjoyable than the standard BLS education:

So many people come and sit in these CPR classes, and [they say] “the instructor last time I took it they breezed through the video and they just clicked on some slides and breathed on a mannequin for a bit and that was it,” and they said, “I actually think that I understand it now.” And we incorporate in our education a lot more hands-on in real world–type scenarios where we really try to get them to understand what it’s actually going to be like if you ever have to be put in the situation.

—Non-transport fire mid-level manager, Site 5

In some systems, the implementation of simulation training as part of broader quality improvement bundles has been associated with improved telecommunicator performance (Meischke et al., 2017) when applied in the dispatch setting, and improved cardiac arrest outcomes and survival in the setting of first responders (Bobrow et al., 2013). The AHA has also advocated the inclusion of teamwork and leadership training in their updated education guidelines, and has suggested deliberate practice—goal-based, rapid feedback, repetition—as a model for optimized training (Cheng, Magid, et al., 2020). For all stakeholders, systems should consider purchasing high-quality training materials, such as high-fidelity simulators and real-
time feedback devices. As of 2017, the AHA has actually mandated the use of real time feedback devices in adult CPR training (AHA, 2017).

I think the best thing that could be done for an agency like ours would be higher-quality training materials and whatnot to work with, because you can simulate cardiac arrest all you want but without the really nice equipment to work with, it’s not going to help a whole lot because dummies are 140 pounds at most. Easy to use. They’re tiny and everything is easy.”
—EMS quality improvement (QI) manager, Site 6

The AHA recommends the use of real-time feedback devices and supports high-fidelity mannequin use with the caveat that systems must be resourced sufficiently with trained staff and infrastructure to maintain them (Greif et al., 2020). This purchasing can be facilitated by pursuing grants or donations.

Finally, involvement of the medical director during training might have value as a mechanism for improvement, as the director can familiarize staff with their clinical leadership and become more familiar with the providers they oversee (American College of Emergency Physicians, 2018; Hagen, 2014). A midlevel manager at a transporting EMS agency stressed the importance of medical director involvement in EMS education programs:

[Medical directors should] at least schedule one or two classes during that initial program, to come and be the speaker. And then, at the same time, that person, the medical control doctor, would be seeing the providers that are about to work under him right at the entry level. I would like to see way more of that. I think that’s really important and it’s not happening here, it might be happening elsewhere, but it’s not happening here.
—EMS mid-level manager, Site 6

Many of the strategies in the earlier components of this report cannot be implemented without a solid foundation of knowledge and skill development from a robust initial resuscitation training program. Emergency response systems should consider their depth and quality and identify areas where they might be improved.

Strategy 32: Ensure That Recurrent Training Occurs on OHCA Topics

Studies have shown that resuscitation knowledge can decay rapidly following initial training. This might be especially true in systems that have a limited number of OHCA calls each year. Recurrent training on OHCA topics should occur for all involved professional stakeholder groups: telecommunicators, police, non-transport fire, and EMS. Consideration should also be given to any special categories of responders, such as lifeguards and county, state, or national
park staff. System champions should make recurrent training available to responders at convenient times and must weigh the benefit of training against the operational costs of pulling units out of service to participate. First responders expressed a desire for additional training beyond the standard two-year refresher, whereas the frequency and level of training might vary:

> It seems like sometimes you get trained and all of a sudden a year or two down the line, it's like, oh, we [have to] get trained again, just to keep it fresh, so maybe a consistency, once-a-year training, for sure, and not every other year . . . and even if our so-called certificate expires in two years, I think we should still be trained once a year, stuff like that.

—Police field staff, Site 3

> Well, he knows who to put in what position to be successful because we've . . . we do this call two times a month just in training.

—Fire-based EMS paramedic, focus group, Site 3

Studies have suggested that more-frequent booster training confers improved CPR performance. The AHA has recommended that booster sessions be implemented for systems that use the standard initial curriculum for BLS (Cheng, Magid, et al., 2020). Although a single study examining the efficacy of boosters at various intervals found that the frequency of booster training was positively associated with CPR performance levels, that same study noted that participation in booster sessions waned as frequency increased (Anderson et al., 2019). Because responders and their agencies must frequently balance competing demands, there is likely a balance between training frequency and other operational demands, which system champions must be aware of when planning recurrent training sessions. As one EMS administrator noted, balancing operational responsibilities and financial realities with time for training and other quality improvement initiatives is difficult for busy EMS systems:

> Ambulance crews are so, so . . . they don't have a lot . . . of downtime to train . . . EMS, to be cost effective, and that's the challenge . . . it's not so much the organizational barrier as it is . . . the federal and state reimbursement barrier. If there were more financial resources for the agencies, I think we could . . . provide better delivery of health care.

—EMS administrator, Site 0

In systems where responders have to balance obligations to emergency services and other full-time jobs, it becomes especially important to ensure that training opportunities are provided during times that are convenient:
First and foremost is making good quality training to our people available, and when I say, available, I mean in a convenient manner so they can fit it into their schedule, their work schedule and their life schedule.

—Champion, Site 5

Strategy 33: Consider Cross-Training Responders in Multiple Roles

Cross-training refers to the training of a single individual in the knowledge and skills required to perform multiple jobs. In the context of public safety, this would refer to training police or firefighters as emergency medical technicians or paramedics as firefighters. For the purposes of this report, we focus on certifying/licensing non-ambulance responders (e.g., telecommunicators, firefighters, and police officers) as EMS providers. A key informant highlighted that one advantage of cross-training providers is that it helps clarify responder priorities and needs and facilitates collaboration on scene:

There’s a lot of people that are hired or employed in both sectors, so that’ll be on . . . like myself, [Fire Department 2] plus [EMS 1], so there’s a good base of knowledge and working knowledge that you run into [Fire Department 1] and have quite a few people that are employed here at [EMS 1]. In my department, there’s also quite a few with the ambulance company in town, [EMS 2]. So, the knowledge is there of the understanding of what needs to happen next and that makes it so easy.

—Firefighter, focus group, Site 2

This practice has been implemented in various places and resulted in positive improvements in patient survival and CPR performance (May et al., 2018). In some places, this training has been in the initial curriculum for responders, such as in police and fire academies:

Some [police] academies are now requiring emergency medical first responder, whatever it’s called, in whatever state, but most of the time they hand it off to us, then we give them task direction and they’re good, and if we don’t they’re not really proactive, but it’s still helpful.

—EMS field staff, Site 6

The ability of first responders to provide higher levels of care becomes especially important in rural areas, where secondary responders might have delayed arrival times because of fewer resources and larger geography:
I mean, especially when you’re talking a rural type of community . . . you’re going to have law enforcement arriving before fire and you’re going to have fire needing to get things done, and why wouldn’t we utilize our law enforcement partners to help in that? But before we do that, we need to train and outfit them.  
—Non-transporting fire administrator, Site 5

Another informant stated it is important to ensure that cross-trained providers receive refresher training to keep their skills sharp and that any additional training the responder receives still occurs at times that work with their busy schedules:

If I were to be trained more medically versus stopping the bleeding and high-quality CPR, beyond that, repetition. You know, if we don’t use something, like in sports or martial arts—if I taught you a technique in self-defense, you never used it . . . . In the street, you’re going to say, “what do I do here?” You’re going to revert to back to what you know. So, my first question is, okay, I get trained in something else beyond high-quality CPR and stop the bleed, am I going to get continued training to make sure my skill set is fresh enough to provide competent help on the scene?  
—Focus group participant, Site 5

Furthermore, cross-training of providers is also subject to the same limitations as other training in that, in many communities, responders have other obligations that they must balance with the training and operation demands of the public safety role:

It’d be nice to have more training and to do the other stuff but, like me, it’d be too hard, and some of the other guys . . . I mean unless you’re not married and supporting a wife and kids, I mean it’s kind of hard to . . . It was tough going through Fire I and II for six months . . . to do another six months to get your basic EMT.  
—Non-transporting fire mid-level manager, Site 6

Material Resources

Earlier in this report, we discussed various equipment that might be used during an OHCA incident. For that equipment to be available, someone must procure it and maintain it.

Material Resources Strategies

This section will provide one strategy regarding grant development for public safety agencies:
34. Invest in robust grant writing resources.

**Strategy 34: Invest in Robust Grant Writing Resources**

Effective systems must know how to appeal to potential funders to obtain additional funding. Grant funds can be used to pay for training, communications, and clinical equipment, and software that can streamline documentation and quality assurance processes. Several sites, especially rural ones, reported that they used grant writing processes to pay for the resources that their agency needed when local funding was not available:

Well there [are] a lot of grants. Now [are] there a lot of grants for an AED or any of equipment or any training? I don't know that . . . [W]e're self-taught and we've written a lot of grants over the years and I don't even want to use a dollar figure because it's been a lot of money we brought in (trial and error is what it was).

—Non-transporting fire mid-level manager, Site 6

The gentleman I was telling you about that was doing all the CPR classes, I think in the last 5 years that he was here, he got close to 30 AEDs off that grant program that we have now throughout the community.

—EMS leadership, Site 5

Obtaining grant funding is, of course, its own challenge. Agencies might be competing with dozens to hundreds of other agencies for the same funding opportunities (Newell and Caves, 2015). And even willing nonprofits might not be able to provide funds to all types of agencies (Newell and Caves, 2015). To maximize the chances of successful funding, some have recommended that organizations focus on grants that correlate to their agency’s size. Smaller organizations should focus on local or regional grants, and larger organizations should focus on national or large corporate grant initiatives (Yuen, Terao, and Schmidt, 2009). If feasible, stakeholders should invest in the skills of grant writers to ensure that their system can fund and access the most up-to-date technology and resources. In communities with fewer resources, coordination with other small communities on writing grant proposals or sharing grant-writing experts might be an effective strategy to obtain grant funding resources that otherwise might not have been available (Whooley, Gregg, and Moscovice, 2009). Grant writers should still consider the needs of other stakeholders and ensure that purchased equipment and programs are compatible with those of other stakeholder groups:
[EMS has] Philips heart monitors. So, they ended up basically getting a grant to replace all the first responders’ AEDs to Philips AEDs. So, all of the pads that we use, all we have to do when we get there is turn our heart monitor and, if they got them on the AED, which they do, we unplug their AED and then plug in our heart monitor.

—EMS mid-level manager, Site 5

Organizational Culture

The culture of an organization touches every part of its operations, including its care for OHCA. It can be a powerful catalyst for performance improvement or an enormous barrier to growth. Establishing a culture of excellence has previously been reported as a key step in improving cardiac arrest outcomes (Graham, McCoy, and Schultz, 2015; Resuscitation Academy, 2020). Features of such a culture are a shared drive to complete a mission that overcomes fear of or resistance to change and encourages collaboration, affirmation of success, and desire and willingness to improve (Graham, McCoy, and Schultz, 2015; McCoy, 2018).

Public Safety Agency Culture Strategies

This recommendation focuses on the role of agency leaders in enhancing agencies’ resuscitation culture:

35. Encourage agency leaders to enhance the resuscitation culture of their agencies.

Strategy 35: Encourage Agency Leaders to Enhance the Resuscitation Culture of Their Agencies

The culture of the individual agencies in an EMS system plays an important role in dictating the agency’s willingness to learn, improve, and collaborate within the system. Engaged cultures are viewed as keys to success; poor cultures are seen as hindrances. Especially notable in our interviews was the engagement of first-responder agencies with medical response. One stakeholder attributed success at one site to the police’s engagement in cardiac arrest response:
The cornerstone of successes like that is [the police department’s] willingness to actually become engaged. You know, they could easily have driven a little bit slower or got there and said, “hey, tell Fire to step it up, this guy doesn’t look so good,” and then just kind of have a concerned look on their face, but their culture is to actively get engaged even though they didn’t check the box to become fire or the paramedics or whatever. This is just kind of the ancillary part of their occupation, but they are willing to step up and they are willing to take an aggressive action.

—Fire training officer, Site 1

Another highlighted leadership traits that might act as a barrier to care optimization:

[The law enforcement administrator is] a few years older than I am, so I think he’s close to retirement and I think it’s just hard . . . . Change is hard . . . . I’ve always taken the attitude that we have to be evolving all the time because I think medicine evolves, so I think it’s just a different culture, medicine versus law enforcement, and [the law enforcement administrator is] a little stubborn, a little bullheaded.

—EMS administrator, Site 5

System architects should encourage the leadership at individual agencies within their systems to foster optimized resuscitation cultures that are collaborative and learning. This can be done by hiring personnel who can enhance the agency’s culture, setting high expectations early on and enforcing those standards, and fostering a culture that appreciates and embraces ideas of staff from all levels of the hierarchy. A key informant stated that hiring to “optimize your culture” is a key step. There is great value in bringing on personnel who are engaged in the agency’s mission and want to see it succeed:
I’m going to say if you’ve got a limited amount of resources to invest, invest it on the front end of who you bring into your organization. The hiring process and how you bring people in and how you train them early on makes a world of difference because people . . . . have a great amount of initiative when put in the right situation. We went to 24-hour staffing here. It was done by six guys who just bought in and wanted to do and did it very well. That led up to years later when we went ALS and we had what, 12 paramedics on the department? We had 12 paramedics and 12 non-medics and guys just bought in and guys worked overtime and guys did a lot of stuff extra because they’re good guys . . . . so matching the people you bring in to what your goals are is vital. Not just hiring the number one guy on your list but hiring the people who are the best match for what you’re trying to accomplish is, I think invaluable.

—Fire-based mid-level manager, Site 3

Hiring efforts need to extend beyond just initial recruitment into who is best suited to oversee key training and programs. One focus group participant noted that resuscitation education jobs should be given to people who are excited about teaching it because they will get more engagement and see better results than someone who does not want to be there:

My advice would be, find the people that want to learn, and find the ones that can talk to people in a positive way. You get positive leadership and people naturally want to listen to them . . . . That will do a lot better than getting the guy counting the days to retirement and [him] trying to teach somebody . . . and . . . not . . . care about it.

—Paramedic, Site 5

When attempting to instill positive culture at an agency, one agency noted that it is also important to set high expectations and enforce them even if that means drawing hard lines and rooting out problematic behaviors:
In fact, we just had an issue with two employees that we self-reported to our [medical oversight body]. They concurred with us, and those two people were terminated, and they were four-year employees. And that’s something we haven’t done before, but it showed that we’re going to hold the expectations high, and we’re not going to put up with anybody’s poor attitude. So that’s supported by the city manager, it was supported by the chief, and even the firefighter’s union. They realized that all it takes is one or two bad apples and it could wreck everything, and we worked hard to get to where we’re at—we really did.

—EMS executive administrator, Site 1

A key informant suggested the importance of embracing the ideas of newer staff rather than letting more senior staff be the only driving force for change:

We really sort of embrace that and if we find somebody that has a lot to offer, we bring them in and we want them to do training. I worked at other fire departments where if you were the new guy and you went and taught one of the old guys what to do. They’d be like “what do you know, you just started, you don’t know what you’re doing.” . . . So, we’ve tried to push that culture out. We want everybody to share the information because the outcome is what matters.

—EMS administrator, Site 1

Listening to and incorporating the ideas of less-senior staff can help build organizational momentum, foster more employee engagement, and make newcomers feel more welcomed in the organization (Hörberg et al., 2018; Kirkland, 2020). Unfortunately, in the public safety setting, grassroots cultural change can be a challenge, and experts generally agree that leadership sets the direction of the organization (DiGiovanna, 2021; Fitzgerald, 2022; Graham, McCoy, and Schultz, 2015; Kirkland, 2020; National Highway Traffic Safety Administration, 1997; Resuscitation Academy, undated). Too frequently, cultural change in these institutions occurs by attrition rather than intention. For example, changes in leadership at one agency conferred significant changes in practice and performance:
We started our improvements in 2013, and since that time we've had a huge transition in our police department where we have a new police chief, whole new command staff, and many retirements. So, we have a very young workforce and people who are enthusiastic and engaged and want to learn and work hard. So all those things have benefited.

—Fire-based EMS administrator, Site 3

Unless driven by leadership at a specific agency, it might be hard to externally facilitate change at the agency level. System-level regional protocols or multi-agency agreements might need to be implemented to push entrenched organizations in progressive directions. Despite such challenges, the impact of culture on ensuring optimal outcomes cannot be overstated.

Public Safety Quality Assurance

As discussed earlier, quality improvement processes need to be in place through the system, at all levels. Perhaps the easiest quality improvement initiatives to implement are those at the stakeholder level, as only one affiliated group is required to agree to and implement these processes.

Public Safety Agency Quality Improvement Strategies

Strategy 36 addresses public safety quality assurance:

36. Develop a structured quality improvement program for cardiac arrest.

Strategy 36: Develop a Structured Quality Improvement Program for Cardiac Arrest

For each stakeholder agency in a given emergency response system, there should be a structured OHCA quality improvement program designed to optimize the contributions of that agency to the overall systems. The program should track measurements that connect to the role of the agency. According to an informant, performance assessment is core to the mission of the fire service:

The core purpose of the fire department is to save lives and property, so my question to people who don't track data is, “how do you know if you’re successfully completing your mission if you don’t know what your numbers are?”

—Fire-based EMS administrator, Site 3

Dispatch agencies should be tracking their recognition rates, successful T-CPR initiation, and key event times (such as time to recognition and time to first compression) as suggested by the AHA T-CPR performance measurements (Kurz et al., 2020). First-responder BLS agencies and
advanced agencies should keep track of measures of success associated with high-quality CPR and early defibrillation. Quality improvement programs should focus on education and be nonpunitive. At the same time, responder awareness that their calls are being reviewed might contribute to better performance, as suggested by one key informant:

Either the EMS coordinator or myself or the fire chief are going to be asking them questions if something doesn’t look right. So, they are being held accountable, so I think that raises the bar a little bit.

—EMS executive administrator, Site 1

Quality improvement programs for telecommunicators have been associated with improvements in T-CPR performance and cardiac arrest outcomes (Gram et al., 2021; Ng, Leong, and Ong, 2017). Unfortunately, as of 2015 (the most recent data available), only about 20 percent of emergency communications centers have these programs in place, despite being recommended by the AHA, Resuscitation Academy, and the CPRLifeLinks initiative (Sutter et al., 2015).

When considering the implementation of a quality improvement program, an agency must weigh the cost of quality improvement initiatives against the cost of poor quality (National Highway Traffic Safety Administration, 1997). Although full review of all cardiac arrests is an admirable goal, resource demands might make this difficult. Therefore, it is reasonable for systems to start with a subset of calls to review as a sample of performance; for example, by reviewing all bystander-witnessed, shockable cardiac arrests.
In this chapter, we discuss strategies for ensuring that everything comes together well during OHCA response—ways to “grease the gears” of the system and make sure that each part overlaps with the others in the best possible way. It is important to develop a high-level understanding of not only how each component works but how they all work together. Fostering positive community relationships with the resuscitation system and between system components is critical for successful OHCA response. To make effective relationships a reality in an emergency response system, fostering open communication; maximizing familiarity; and leveraging training, consolidation, cost-sharing, and system standardization are needed.

Cultivating Community-Institution Relationships

Communities and first responders should develop relationships with one another to better serve their residents. Fire leadership emphasizes the importance of letting the community know they are dedicated to building a relationship. This includes explaining what a response looks like when help arrives on scene and the purpose of actions taken. Individuals might not be familiar with fire providing medical support. In some cases, fire is first on scene and is equipped with the medical training required to treat the patient. Similarly, educating the community to understand that police on scene are there to help and assist in an incident is critical. Such education can help remove potential pushback on police presence or the provision of medical care by police:
We get a lot of folks who may not be accustomed to a fire response . . . . So, we educate our residents or business partners here as well as to why they get the fire engines there . . . . We’re dedicated to our geographic location. So, we let everyone know basically, we have nothing less than a stretcher. We have a whole, full capable paramedics on the rig, we have ACLS intervention available on the rig. . . . We have everything basically up to and including what the emergency room may have, I mean, just other than the ability to transport you from that scene that moment, but your care is not suffering. You’re receiving the same care you would be getting that they [provide] . . . . [in the] back of that ambulance, and some may argue better care . . . . And again, we’re trying to educate folks that you’re not getting a lesser product by having the fire department there.

—Fire leadership, Site 8

Every time I do a first aid or a CPR class myself—because I do that independently as well—I handshake every participant, as well as give them a gift for participating because every time they respond and they start before I get there is time saved and opportunities that a person’s going to live. And so, that communication with others and letting them realize how much they truly are needed, I think, is big. I think the AHA, pretty much that chain of survival is critical and educating the public on how important it is.

—EMS leadership, Site 6

_Cultivating Community–Institution Relationships Strategies_

We have one strategy focused on community engagement:

37. Engage with community organizations.

**Strategy 37: Engage with Community Organizations**

Engagement between responder organizations and local businesses can aid in developing broader community preparedness throughout an emergency response system’s geography:
We’ve ended up training some of our hotel . . . restaurant . . . and . . . bar people, and we placed AEDs in the middle of town and at the end of town and up at [Area 1] and trained all the people that we could in-between . . . . One of them is at our gas station that is in the center of our town, and one of them is at our bar that is at the outskirts of town, and one of them is all the way up at [Place 1] at the [Place 2], and we actually have some out at [Place 3], and I teach the DNR officers, as well. So, try, kind of like [City 2], to strategically place things so that, hopefully, bystanders can help, too.

—EMS mid-level manager, Site 6

Local businesses can support CPR training for their employees and provide funding for additional resources for public safety agencies. System champions might wish to engage with other local government entities, adult foster care homes, outpatient medical facilities, nursing homes, school systems, youth clubs, parent-teacher organizations, religious organizations, service organizations, and businesses (Fire and Emergency Service Image Task Force, 2013; Heart Rescue Project, undated-b).

The HeartRescue Project’s *Community Response Planning Guide for Sudden Cardiac Arrest* recommends engaging these key organizations using the following steps:

- Identify the stakeholders and influential leadership in the community.
- Research their missions and consider what might motivate them to want to join forces.
- Craft individualized messages with those missions in mind.
- Tie that message to a specific request (e.g., for training employees or donations for equipment) (Heart Rescue Project, undated-b).

They also advocate obtaining a written commitment for any partnership agreements made (Heart Rescue Project, undated-b). Another way to engage community organizations is through a service partnership in which an organization contracts with the EMS agency to provide medical coverage at events such as football games, art fairs, farmers markets, concerts, and charity races:

Now we are paying four full-time wages. We had to find the money to do so . . . . We contracted with a test track and a couple other contracts that we increased in order to make that happen. Because now we have four here at the station, we have a better, quicker response with more people to those, and I think that’s huge, I do. That would be the biggest policy change that we’ve had.

—EMS mid-level manager, Site 6

Once partnerships have been established, they also must be maintained. One site has attempted to do that by recognizing on an annual basis their community partners who contribute in meaningful ways:
We have that AED grant program . . . . where we . . . . at our annual awards dinner would . . . . recognize new businesses that implemented AEDs and purchased AEDs. We . . . . take stories from our cardiac arrests and we give our lifesaving awards to the community members.

—Focus group participant, Site 1

OHCA champions might consider community organizations as untapped resources in the local area.

Cultivating Institutional Relationships

Relationships between the emergency services and health care agencies that make up the professional system of care are also important. The National Highway Traffic Safety Association’s EMS Agenda 2050: A People-Centered Vision for the Future of Emergency Medical Services lays out a future in which “EMS services collaborate frequently with their community partners, including public safety agencies, public health, social services and public works,” and “communication and coordination between different parts of the care continuum are seamless, leaving people with a feeling that one system, comprising many integrated parts, is caring for them and their families” (EMS Agenda 2050 Technical Expert Panel, 2019). Unfortunately, in many systems, political and bureaucratic barriers pose an enormous obstacle to system optimization. If the disparate emergency response systems of today are to achieve the vision of seamless integration, those systems need to start collaborating today, and OHCA champions can be key to facilitating those partnerships.

Cultivating Institutional Relationships Strategies

We developed two strategies for cultivating institutional relationships:

38. Establish a culture of open communication among institutional stakeholders.
39. Maximize the frequency of crew interaction in both emergency and non-emergency settings.

Strategy 38: Establish a Culture of Open Communication Among Institutional Stakeholders

For a system to operate effectively, the components of that system need to have open lines of communication and a way to evaluate how each component’s performance is affecting the performance of others. OHCA champions should work to establish stakeholder relationships that create a sense of shared trust and receptiveness to feedback from people outside an organization. This culture of open communication must extend from the operational units to the administrative units within organizations. When communication is cut off at any level, outputs can get out of sync, and the system can waste resources, fail to produce desirable outcomes, or collapse.

Operational staff (e.g., field paramedics, police officers, firefighters, nurses/doctors) have
recurring opportunities to practice this culture of open communication on joint runs and at transitions of care, but this is not necessarily true for stakeholder administrative leadership. Thus, it becomes especially important for administrators to be intentional about having recurring and frequent communication with their counterparts at partner organizations (Fitch, 2019). Dispatch, police, non-transport fire, EMS, hospital, and the leadership of other involved stakeholder groups should meet regularly:

Quarterly, I have a meeting with the [EMS Agency 1] supervisor and he will either come here or I’ll go over there . . . . We’ll have a cup of coffee and we’ll go over any problems we’ve had with crews on the scene . . . . it’s just a roundtable, and we discuss and just kind of get our problems set aside and move forward.

—Fire administrator, Site 3

When I worked down there, there was no interaction with the sheriff at all. When I came here, I noticed that there were sheriff’s deputies in here sitting down, they were talking with the crews and stuff like that and that’s how they solved their problems. You know, they’ll sit around, and I should say, kind of “BS,” but they’re talking about different things and when you see them on scene, these guys and gals interact together, and they work well.

—Non-transport fire administrator, Site 3

This type of communication is facilitated by the culture of the agencies involved and, in some cases, existing leadership. It might even have a positive effect on outcomes. A study examining how hospitals and EMS collaborate on the closely aligned issue of heart attacks found that hospitals that invested in strategies to foster more-effective communication with EMS tended to have better performance on critical heart attack benchmarks than those that do not (Landman et al., 2013). Another study examining relationships between EMS and hospitals found that sometimes EMS’s understanding of what the hospital wanted from their verbal reports was different from what hospital staff actually wanted (Troyer and Brady, 2020). Breakdowns in communication such as these undermine the effectiveness of the system. Lines of communication are also likely influenced by the presence of other relationship-fostering activities in the systems, such as maximized stakeholder interaction and interdisciplinary training, both of which we discuss later.

Another way to facilitate communication across institutions is to establish an OHCA coordinating committee representing each stakeholder group, including the community, to ensure everyone has a voice in system improvement projects:
We nicely talk about champion in the singular, but I really think that the more successful systems out there, it really is plural . . . . [T]here are champions in all the different elements and components and agencies, or multiple champions that feed off of one another and really work collaboratively.

—EMS physician, Site 2

Strategy 39: Maximize the Frequency of Crew Interaction in Both Emergency and Non-Emergency Settings

Another strategy to optimize collaboration between system stakeholder groups is to increase the frequency with which stakeholders interact. Simply responding to calls together can build familiarity and trust, but systems can also be more intentional. Non-emergent job responsibilities can ensure that professionals from different backgrounds cross paths in their day-to-day work. Agency, union, or social leaders from various stakeholder groups can organize formal or informal opportunities for co-recreation. This allows stakeholders to get to know each other free from the stress of an emergency scene:

Yeah, there is a family wall. You know, we’re doing [Site 1 Program 1] University too. [Site 1 Police 1] told you about that, so just breaking down those walls even further, touring all their fire departments, seeing who’s in charge of everything. Two firefighters are, let’s say, checking all of our AEDs. They are light-duty fire officers . . . . And they’re like, this is so . . . we were just talking, we’ve both worked here for 18 years, we’ve never been beyond the front desk. So, we’ve been to your jail and the front desk. We’ve never seen where everyone works . . . . Once you meet someone and you go to their office area, there’s just a certain easiness when it comes to future relationships, and so maybe that’s helping as well.

—Police officer, Site 1

It seems reasonable that in day-to-day non-emergent operational tasks, stakeholder leadership can find projects or means by which stakeholders can interact with each other. The presence of shared dayrooms or inviting officers to stop by a station or facility for lunch can increase these relationships:
We just had [County 3] Sheriff’s Department come through in two sittings with their entire group of staff on a meet-and-greet—come see what our world looks like, so we know what’s happening on the other end.

—Dispatch staff, Site 2

A couple of guys are playing hockey with some other guys, a couple of guys [say] “Hey, we’re going out on the boat if you want to come.” So, you actually end up developing friendships and consequently, you develop that relationship, so we like the officers and they like us, so we’re willing to do whatever we need to do when they need it and they’re willing to do the same for us.

—Firefighter, Site 1

These activities might be organized by social leaders or could be formal union activities. When organizing them, leaders should consider the involvement of all system stakeholders, as appropriate. Beyond these day-to-day interactions, system champions might consider implementing interdisciplinary training practices into their system.

Interdisciplinary Training

In contrast to cross-training, which has been mentioned previously and involves training a single responder on multiple roles (e.g., firefighter/EMT), interdisciplinary training involves multiple stakeholder groups intentionally training together to foster the development of shared understanding and rehearse roles prior to a major event. This provides a low-stakes opportunity for responders from different backgrounds to learn about each other’s needs and get used to working together. Joint exercises are common in the military realm but have only partially penetrated the emergency responder world. That said, they present an excellent opportunity to improve an agency’s system of care for OHCA.

Interdisciplinary Training Strategy

Strategy 40 focuses on collaborative training:

40. Implement collaborative training opportunities across stakeholders.

Strategy 40: Implement Collaborative Training Opportunities Across Stakeholders

Collaborative training opportunities involve representatives from two or more stakeholder groups (i.e., system components) who engage with each other on a specific topic (Graham, McCoy, and Schultz, 2015). Interviews and focus groups suggest that such training occurred regularly for special incidents, such as active shooter emergencies and hazardous materials situations, but was less commonly reported for cardiac arrest. Some respondents pointed out that collaborative training allows participants to get to know each other and to ask questions of
stakeholders from different backgrounds, thus enhancing responders’ understanding of the roles, responsibilities, and frustrations of their co-responders. This, in turn, allows the responder to adapt behavior to make the jobs of others easier. We highlight four types of collaborative training: conference attendance, familiarization opportunities, joint training, and centralized training programs.

**Conference Attendance**

One opportunity that system leadership can leverage is to send responders to external conferences or systemwide conferences to facilitate the cross-pollination of ideas:

> Our department also sends us to a yearly conference that the software has and it’s really incredible . . . . The networking is great. They have different types of scenario-based training with the software enhancements, but you really get the opportunity to talk to people and say, “well, how are you using it?”
> 
> —Dispatch administrator, Site 1

**Familiarization Opportunities**

Agencies should also implement training opportunities that allow responders to familiarize themselves with the roles and responsibilities of others in the system. Someone who understands the needs of their colleagues is more apt to respond to those needs than someone who does not:

> We actually take the paramedic students from a local college . . . and while in our ER, they sit and listen to the radio for two full days . . . . I want them sitting by the radio and hearing what they sound like, and . . . you can tell how much better their communication over the radio is.
> 
> —Nurse manager, Site 1

> So we spent a whole day at the fire department, and they taught us what they do, who they are, and stuff. We do go there for our training once in a while, like putting on tourniquets and the CPR stuff, they’ll help out too sometimes, so we have seen those, but to see what everybody does, I think just helps.
> 
> —Police captain, Site 1

These familiarization trainings have been advocated to improve relationships between EMS and ED staffing and providers (Holland, undated; Patel, 2018)

**Joint Training**

Agencies should also leverage joint training opportunities to ensure that all stakeholders have a chance to practice responding to OHCA emergencies with their collaborators:
I think one of the benefits . . . . makes it so that we . . . . have a good working relationship is that we practice together. We have had county trainings where we’ve brought fire departments . . . . and paramedics . . . . and we practice working this cardiac arrest on a mannequin . . . . We talk about it afterwards and do an immediate debrief and say, “these are the things we can do better; these are the things that are going great.”

—EMS staff, Site 2

These joint training sessions provide key opportunities for professional responders to ask questions in a low-stakes setting that can help them understand the needs of the people they work with:

[The training] was open to where we could ask questions: “Well, what do you want on a scene like this, if they’re down and we’re just doing CPR? Do you want us to do this? Do you want us to wait? Do you want us . . . for the transition . . . How do you want to transition from there? Do [you] want us to start gathering information, medical lists?” . . . So, being able to personally talk to the people you’re going to be dealing with . . . is very beneficial to us and . . . then being able to communicate that between all three [stakeholder groups] is pretty important.

—Police field staff, Site 3

Centralized Training

Another strategy for collaborative training is to implement centralized multidisciplinary instructor teams composed of instructors from various disciplines:

Full-time fire, I think, we’ve got right now seven instructors that are both divisions. We have police instructors, we have fire instructors, but it’s all-American Heart CPR, so we sent them through the certification course and they go out and they teach it together and they do that. And that’s why it’s important, for us anyways, is my fire division is training my police division in CPR and my police division is helping train our fire division in CPR. That way we’re all on the same page, we all received the same training.

—Non-transporting fire administrator, Site 5

Agencies and other organizations might consider implementing something similar, using existing multidisciplinary team frameworks (e.g., technical or dive rescue, hazardous materials) to create their own multidisciplinary resuscitation instructor team that would be responsible for ensuring that all system stakeholders are trained to the same standard and choreography.
Collaborative training programs might have numerous positive effects across operational coordination, cultures of communication, and system efficiency. There are few high-performance teams across all of society in which all components of the system practice by themselves and then try to put it all together for the actual event. Imagine a play in which the lighting and sound design team never attended a rehearsal, or an athletic team in which the defense and offense never practiced together. They might be able to figure things out in real time, but fine details would be missed, and quality would suffer. Therefore, collaborative training might act as a key to a high-performing OHCA system of care.

Collective Resource Management

Working together allows the community to achieve things that no individual could achieve alone. Another way to form a more collaborative system is to share resources. This not only has the effect of providing more resources for everyone involved in a system but also can strengthen relationships because of the interaction necessary to manage the sharing process.

Collective Resource Management Strategy

Strategy 41 addresses resource sharing:

41. Consolidate high-cost resources as a mechanism to provide optimal care for the community.

Strategy 41. Consolidate High-Cost Resources as a Mechanism to Provide Optimal Care for the Community

As the technological requirements for public safety services continue to increase, some systems have turned to service consolidation with other regional agencies to ensure that their communities have equitable access to the most modern interventions and care. Dispatch centers have consolidated with other dispatch centers to ensure they can afford the latest technologies for computer-aided dispatch, call taking, quality assurance, and geographic information system (Center for Public Management, Maxine Goodman Levin College of Urban Affairs, Cleveland State University, 2011). Fire agencies have consolidated their services across municipalities to enhance the cost-effectiveness of their service (“Fire Department Consolidation Models,” 2013; International Association of Fire Chiefs, 2013). EMS agencies can consolidate with other EMS agencies to stay viable as reimbursement rates stagnate (FAIRHealth, 2022). Sometimes agencies can consolidate across disciplines, with varied results (Wilson, Weiss, and Grammich, 2016). In our study, responders praised both their centralized EMS system and a consolidated dispatching system that had emerged in recent years:
I mean as far as the dispatch is concerned, it’s nice for me because I know who I’m paging right away, you know? Sometimes I’ll hear . . . depending on the borders and the township, you’re not sure—okay is it this agency or this agency?—who responds to it, but with [County 3], [County 3] EMS, you know they’re going to handle it.

—Dispatch field staff, Site 6

Well, with the advent of 911, enhanced 911, there was new equipment that needed to be purchased by both counties and they were smart enough to get together and say, “hey, you know, we can save money if we do this,” and they consolidated Central Dispatch. So, the county commissioners got together, and when they did that, not only did we enhance the dispatch center, but both counties, they installed new radio equipment for the first responders for Fire and EMS.

—Dispatch mid-level manager interview, Site 5

For systems struggling to meet the resource demands of modern care for OHCA victims, consolidation of services can be an avenue for reducing overhead costs and improving the quality of 911 services across a region (Lerner et al., 2019). Additionally, consolidation and cost-sharing across disciplines can make key equipment available that individual municipalities could not afford on their own (U.S. Fire Administration, 2012) while refusal to consolidate can result in inefficiencies that deliver subpar products (Agency for Healthcare Research and Quality, 2012).

That being said, it bears repeating that each system is different, and what may work in one system may not work in another. Prior to consolidation of a single resource or an entire agency, pros and cons must be weighed by leadership and the stakeholders that decision will ultimately affect (Fuentes, 2018).

**Regionalization/Standardization**

**Regionalization/Standardization Strategies**

42. Establish a standardized care protocol for all stakeholders
43. Ensure compatibility of the equipment used across responder groups.

**Strategy 42: Establish a Standardized Care Protocol for All Stakeholders**

A single standardized operational policy or protocol agreed on by all stakeholders will facilitate collaboration by ensuring that everyone is on the same page. If such a standardized protocol as this does not already exist, one of the first actions that a newly appointed champion
or coordinating committee might do is draft a proposed protocol that specifies the roles and responsibilities of each stakeholder during an OHCA emergency:

But we operate under the same [standard operating guidelines] essentially, the guideline of how to perform CPR. And so, without having to tell them . . . they line up on each side of the patient to alternate in compressions and one’s at the head, it just makes it less Benny Hill than when you have a bunch of people sitting there and nobody really knows what to do. They’re just all kind of trying to do something as opposed to the organization and the team working together as a single unit.

—Firefighter, Site 2

Protocol makers and medical directors should ensure that the protocol considers all communities within the local geographic area and allows sufficient flexibility for incident commanders and individual care providers to make necessary decisions based on context. For example, one firefighter noted that following a protocol that recommends termination of resuscitation in response to a traumatic cardiac arrest can lead to an appearance of apathy and undermine already shaky relationships with the community:

With the protocols changing and the traumatic arrest protocol, it’s like, that all has a place—but . . . not in the middle of the day when there’s 3,000 people standing there watching you not do anything. I mean, today’s climate is you can’t do that. You have to move. What do they see? They see a bunch of white people standing there not helping a black person that’s bleeding to death. That’s what they see.

—Non-transport fire firefighter, Site 3

Often the protocols and everything are not written with the rural people in mind whatsoever because we’re a very small percentage of the run volume . . . So, a lot of what we go through is not reflected in policy or laws or anything of that nature.

—EMS QI manager, Site 6

Because this study took place in Michigan, all regional stakeholders with EMS licensing must follow the same general cardiac arrest protocols statewide with slight modifications and novel approaches as directed by geographical medical directors. However, the protocols used in other states, and even within the same state, can differ. EMS protocol development can occur at the local, regional, or statewide level, depending on the state in which the system resides (National Association of State EMS Officials, 2020). OHCA champions must understand how
protocols are made in their own jurisdictions so they can determine what meetings and discussions must take place to foster standardization across stakeholder groups.

Strategy 43: Ensure Compatibility of the Equipment Used Across Responder Groups

Beyond ensuring that stakeholders following the same guidelines, it can be helpful to ensure that they are working with compatible equipment. This could mean ensuring the multiple PSAPs have compatible CADs or that the AEDs that are used by first responders can be quickly switched to the defibrillators of advanced providers, or that electronic health records shared between EMS and the hospital work well together:

[Our AEDs] were not compatible with the Fire Department’s AEDs, so generally, if we could beat the Fire Department to a scene, our guys would hook up an AED. The Fire Department comes in, removes our equipment, puts theirs on so that they can start doing stuff. So, actually today, we are implementing the same AED, so, essentially, if I arrive on a scene and I start the AED process, a Fire Department member comes, they can just . . . they can unplug from mine, plug into theirs, and continue on without missing a beat.

—Police and dispatch mid-level manager, Site 3

One bonus of standardization is that it can facilitate restocking practices across the system and reduce waste. In some systems, stakeholders have partnered to facilitate restocking or equipment exchange:

We’ll actually go to [EMS Agency 1] and we’ll exchange O2 bottles and it’s kind of an agreement that we have with them. You know, if we use a 4x4, we get a 4x4 from them. If we use a King tube, we’ll just grab their King tube. You know, so we kind of came to that agreement with them because it benefits [EMS Agency 1] greatly, having us show up on scene along with their crew.

—Non-transporting firefighter, Site 1

At another site, the system avoided wasting AED pads that are close to expiring by setting up an exchange program between EMS and the hospital, which is more likely to have a use for the pads before the expiration date. Standardization and creativity allowed for this unique solution:
We have a program where if they bring [AED pads] to us . . . before they expire, then we'll swap them out . . . . We could have time to use them within six to nine months and then it’s basically like, no charge if they bring them to us before they expire.

—ED nurse, Site 6

These types of exchanges work only if everyone is using the same equipment. Additionally, standardizing this equipment can be useful in the dispensation of grants: Agencies using the same equipment can consolidate their funding requests and argue that a single grant award would benefit more people in a given community because of equipment standardization.

Interdisciplinary Quality Improvement

As mentioned earlier, quality improvement needs to take place at all levels of the system: from the incident level to each stakeholder to a systemwide review process. The system-level quality improvement process should take information for all incidents and all stakeholders and integrate it into a broad picture that can inform systemwide improvements.

*Interdisciplinary Quality Improvement Strategies*

In this section, we discuss two strategies regarding feedback across the system and collaborative review:

44. Provide feedback on OHCA performance and outcomes to all responder groups.
45. Share data in aggregate and review performance jointly.

**Strategy 44: Provide Feedback on OHCA Performance and Outcomes to All Responder Groups**

When it comes to individual OHCA cases, it is important to ensure that everyone involved in the cardiac arrest incident gets feedback on their performance. Unfortunately, in EMS’s current state, there are large gaps persistent in the provision of feedback to out-of-hospital providers (Cash et al., 2017). The lack of integration between EMS patient care reporting software and hospital electronic health records can make this feedback exceptionally hard to obtain (Greene, 2014; Mt. Sinai Health System, 2018), in spite of the fact that improved EMS information systems and integration with other health care records was identified as a national priority in the 1998 EMS Agenda for the Future (Delbridge et al., 1998), an early 2000s Institute of Medicine report (Committee on the Future of Emergency Care in the United States Health System, Board on Health Care Services, and Institute of Medicine, 2007), at the 2010 Academic Emergency Medicine Consensus Conference (Carr and Martinez, 2010), and again in the EMS Agenda 2050 (EMS Agenda 2050 Technical Expert Panel, 2019).

At a system level, connections need to be established to ensure that everyone who was involved in the case learns about its final outcome. This is especially true for cases that are
transported to the hospital because non-transporting first responders and even the transporting crews might never learn the patient’s outcome. Even for cases that are terminated in the field, dispatch staff still deserve to learn the final outcome. Additionally, systems should try to provide feedback to bystanders and organizations who were involved in cardiac arrest resuscitations so that they have an opportunity to ask questions and can receive reassurance regarding a traumatic experience. Because of HIPAA restrictions, agencies might not be able to provide outcome information to bystanders; however, at the very least, they can recognize bystanders and organizations who act for their willingness to do something. One site hosted annual survivor events where they recognized both bystanders and organizations that contributed to cardiac arrest saves:

We have that AED grant program . . . where we . . . at our annual awards dinner would . . . recognize new businesses that implemented AEDs and purchased AEDs. We . . . take stories from our cardiac arrests and we give our lifesaving awards to the community members.

—Speaker not specified in transcript, focus group, Site 1

These types of events help providers and the public understand the ultimate value of the work they are doing.

Providing feedback to everyone involved requires systematic data collection. The facilitating organization will need to know who was involved at each step of the cardiac arrest from each organization and obtain the final patient outcome from the hospital. CARES is a platform that many agencies use to integrate these data and ultimately provide outcomes information to responding crews (CARES, 2021). It collects data from the 911 center, EMS agencies, and hospital systems to provide that integrative view for each case. As we have previously advocated, such information-sharing requires stakeholders to break out of their organizational “silos” and develop a coordinated approach to OHCA response and management at both an operational and administrative level (Bannow, 2014). Another mechanism for sharing performance information with field-level providers is to use a cloud-based system to share defibrillator data that providers can review on multiple devices:
We have an integrated quality improvement program. We use an electronic medical record that allows feedback to be sent to all the crew members. We are in the process of upgrading our defibrillators so they’re all cloud-based, so all the information on them is uploaded to the cloud so then we can share it with every provider.

—Fire-based EMS champion, Site 4

Strategy 45: Share Data in Aggregate and Review Performance Jointly

Agencies should also make sure that all data collected across the various levels of the system are shared in aggregate to all stakeholders within the system. Beyond just incident-level performance, systemwide survival rates and performance metrics should be shared with leadership across the chain of care:

We do a monthly PowerPoint CompStat, and every department had or every group within the entire community, fire and police chips in and . . . everyone has a . . . role in it . . . our cardiac arrest percentages, statistics, how many we had in the last 12 months versus say the last month just looking at the numbers. We look at the ROSC that they got on scene, percentage of it, and then what percent was discharged home without any deficits. We do . . . Every dispatcher will see those numbers . . . We’re required to review it, sign off, understand it every week. It’s just a really . . . It’s a good way to communicate what’s happening on days we don’t work.

—Dispatch field staff, Site 3

This type of feedback can also regularly be provided to the community at large through the publication of annual cardiac arrest reports (Medtronic Foundation, 2017).

System-Level Conclusions

Although improving a single agency is a commendable endeavor, ultimately, all components of the system are interdependent. The chain of survival is truly an apt analogy in that the quality of OHCA care is determined by the weakest link in the emergency response system. Even the strongest link is significantly weakened unless it is connected to all the others. For an emergency response system to function optimally, all the links need to be strong, connected, and well maintained.
Chapter 6. Part 4—Addressing Change Management

Change Management

Change in OHCA systems of care requires steady investment and coordinated action on the part of numerous stakeholders. An OHCA champion or coordinating committee of champions from various agencies can be a powerful driver of change in a system. In this final chapter, we describe strategies that public safety leadership can use to effect change in emergency response systems.

Change Management Strategies

Our final four strategies focus on change management:

46. Understand the red tape, financial barriers, and incentives that an agency must navigate.
47. Involve all stakeholders in changes.
48. Implement change in phases.
49. Run a trial period and gather feedback on the new equipment, policy, etc., before widely disseminating new changes.

Strategy 46: Understand the Red Tape, Financial Barriers, and Incentives That an Agency Must Navigate

Public safety agencies must navigate budgets, politics, and competing demands and roles. OHCA champions must understand the mission of other coordinating agencies, their priorities, and the obstacles that they face:

When I started doing this, our survival rate was zero, and when I said if our mission is to save lives and property and just using cardiac arrest we have the opportunity to practice that saving lives thing 25 times a year and our success is zero, are we accomplishing our mission? And when you phrase things like that and share numbers like that, they’re very difficult to argue.

—Fire-based EMS champion, Site 3

What are the community’s expectations of public safety agencies, and what can those agencies reasonably afford? A key informant at one site noted that their community expects them to have AEDs and they have to deliver on that expectation:
So, when I sit down with our residents and talk to them about how much they’re paying in taxes for a multimillion-dollar budget, and then tell them that I can’t find $12,000.00 . . . that’s not a good answer in this community. So, it’s understanding the community and identifying what the priorities are.

—Police and dispatch administrator, Site 3

Additionally, knowledge of the cost of such things as programs, devices, and software and of the internal processes for implementation is critical. For example, one key informant noted that good ideas can be stifled by the process of making the request:

I think sometimes the stuff gets kind of caught in the red tape and . . . between the [administrative] level and what we’d like to try to do and what we can do physically . . . [I]t might sound easier on paper and sound really good . . . Even moving from AEDs that don’t have active feedback to AEDs with active feedback might be a little more difficult with...the processes and everything else.

—Fire-based EMS coordinator, Site 4

Understanding these barriers and developing plans to overcome them is key to improving OHCA systems through change management. Having this knowledge can help anticipate agency needs and set reasonable expectations for their contributions to the systems of care. This understanding will not only suggest improvements to the system but inform development of a roadmap for how to get there.

Strategy 47: Involve All Stakeholders in Changes

One of the best ways to ensure that a new program is implemented smoothly is to make sure to involve everyone who will be affected by the change. A change to one system or program might result in unintended consequence for another stakeholder who depends on that system for their own functionality. Understanding the implications of these changes for everyone is key to determining when and how to implement a change to policies or practices. Every stakeholder who feels that their concerns have been addressed and takes ownership of the transition can confer greater buy-in on the change throughout the system. One fire agency lamented that a change in the CAD system at a separate EMS agency resulted in problems for their own dispatching:
[Before,] we had CAD notes. We had printouts that told us where we’re going. Everything worked great, and then they switched CAD systems because they’re the ambulance provider, so they had to go with ambulance-based CAD that didn’t have a fire module. So, they’re trying to build the fire module as we go, but they already flipped the switch. We can’t go back. So, it’s a problem.

—Non-transport firefighter, Site 3

This is one reason that having a coordinating committee for cardiac arrest care might be beneficial: It allows everyone to have a seat at the table and to stay informed:

It goes back to the very first thing we were talking about, the training loop of, we found something that worked. We changed it on our end, but we didn’t grab all the rest of the stakeholders and bring them in to the change as well, and that’s something on CPR calls that we should be doing, I think. On any kind of call, we should be doing it. We should be considering those outside our agency who are going to be working with us.

—Fire-based EMS mid-level manager, Site 3

Strategy 48: Implement Change in Phases

Trying to change too much at one time might be overwhelming for stakeholders in an emergency response system:

One thing firefighters hate is change. We can do the same thing for 300 years, and if you try to change it, look out . . . . It’s the world. The world’s going to end.

—Non-transporting firefighter, Site 3

So, I think it’s . . . like any type of change or, people want to do what they’ve done before, and you give them a new tool. And even if you say it’s just as simple as putting pads on and hitting a button, until they’ve done it and had a positive result, they’re kind of apprehensive.

—Police and dispatch administrator, Site 3
The system we had been using before, we had dispatchers who have been here for 15, 20 years and they have years and years and years of muscle memory on that old system, and very quick to get you what you need in 30 seconds, and to tell them . . . anyone in public safety hates change. Cops environment, it’s just they hate change, and you still have a handful of people that go, I’d take the old one back in a second. I just roll my eyes because no, you wouldn’t. It can’t do what this does. But I get it because it’s that years of muscle memory.

—Dispatch administrator, Site 1

In addition, some stakeholders suggested that small changes, implemented in phases, might be effective for improving resuscitation practices. Changing too many things at once can make it challenging to assess which modification to practices or equipment actually created positive or negative effects.

Strategy 49: Run a Trial Period and Gather Feedback on the New Equipment, Policy, Etc., Before Widely Disseminating New Changes

Each phase of implementation should be treated as a trial period in which feedback is gathered and the implementation is adjusted accordingly prior to implementation of the next phase. One fire-based EMS mid-level manager suggests letting crews conduct a trial period following change implementation and to gather feedback. Administrators can benefit from gathering feedback in multiple ways to avoid nonparticipation bias:

So if you’re going to implement something, especially someone coming from me who hasn’t been on the road in a couple years, I’d be an idiot to say hey, guess what, you guys are getting this and you’re using it. You know, you got to let the guys have it and try it and see . . . and get them in the field to see if it is something that we like and that the guys like . . . Usually there’s a lot of complaining around the table, or accolades. [Fire Administrator] has asked numerous times for them to fill out a form. And the guys that truly like them will take the time to write out a form. The guys that think they’re okay are like, eh, alright. And the guys that hate them, they’ll just verbally complain about them. So then when we get them . . . “[W]hy did we get these, they’re terrible.” “Well, did you fill out a form?” “Well no.” “Well, that’s why.”

—Non-transporting fire mid-level manager, Site 8

These trial periods can also include training sessions with simulation in which crews can tweak and modify workflows to determine the most effective system:
[W]e probably changed 30 things we do, maybe more. But the first thing we changed is don’t interrupt chest compressions, and [we] adopted really high-performance CPR. That was the first change, and we went from zero to 50 percent getting pulses back in a year’s time. So, the first response to that is, well that’s just a statistical anomaly, it’s not going to maintain. You got lucky. And then the next year it increased, the next year the data increased or maintained, and now there’s no disputing any of that, and it’s a long process.

—Fire-based EMS champion, Site 3

We took it, we trained on it, we kind of thought what would make it better, and guys are always kind of making those little tweaks. And even, we try to have two guys on the airway just as something that we do, and that’s something that’s just come through kind of trial and error and experience of the guy who’s doing the airway needs somebody assisting him, even if it’s a matter of the one guy’s just holding on the mask, the other guy’s doing the bagging . . . those kinds of things are just things that if we didn’t train on it, we’d still be doing it the same way we did ten years ago. And I think that that’s . . . a big part of that is the culture and the willingness to be trained, to relearn things, and to not fight against something just because it’s different than what you’ve learned.

—Fire-based EMS mid-level manager, Site 3

Change Management Conclusions

Institutional change can be slow. Dogma, politics, and bureaucracy can get in the way of rapid optimization. Steering a slow-moving ship takes time, but it can potentially take less time if one understands the complexities of the emergency response system and involves key stakeholders in a step-by-step quality improvement process.
Appendix. Overview of EPOC Study Report Methods

Key Informant Interviews and Focus Groups

*Emergency Response System Sampling*

We conducted in-depth, semistructured key informant interviews and multidisciplinary focus groups with 911/dispatch, EMS, non-transport fire, and police in emergency response systems with high-, intermediate-, and low-survival outcomes (Table A.1). Using data from the Michigan Cardiac Arrest Registry to Enhance Survival (MI-CARES), we identified prehospital systems with more than five OHCAs between January 1, 2014, and December 31, 2017 (n = 103). We then used a mixed-effects logistic regression to calculate patient-standardized rates of our primary outcome: survival to ED with pulse on arrival. Once calculated, EMS agencies were stratified according to high-, middle-, and low-survival quartiles (Abir, Fouche, et al., 2021). We then sampled nine emergency response systems (e.g., 911/dispatch, fire, police, EMS, ED) consisting of four high-survival, two intermediate-survival, and three low-survival agencies based on rates of ROSC with pulse on ED arrival. Sampling based on performance allowed us to focus on high-survival outcome communities, which are most illuminating for factors associated with improved survival, and to compare those factors with ones exhibited in intermediate- and low-survival communities. Therefore, strategies may stem from comparisons among high-, intermediate-, and/or low-performing sites. As part of the sampling strategy, we looked to include representation from the state’s trauma regions because those represent an existing network of emergency response–related and health care organizations.

<table>
<thead>
<tr>
<th>Urbanicity</th>
<th>Performance</th>
<th>Geography</th>
<th>Transporting EMS Structure</th>
<th>Site Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urban</td>
<td>Intermediate</td>
<td>County</td>
<td>Private, nonprofit, ALS transporting agency</td>
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</tr>
<tr>
<td>Urban</td>
<td>High</td>
<td>City</td>
<td>Fire-based, ALS transporting agency</td>
<td>1</td>
</tr>
<tr>
<td>Urban</td>
<td>High</td>
<td>County</td>
<td>Private, for-profit, ALS transporting agency</td>
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<td>Low</td>
<td>City</td>
<td>Fire-Based, ALS transporting agency</td>
<td>7</td>
</tr>
<tr>
<td>Urban</td>
<td>Low</td>
<td>City</td>
<td>Fire-Based, ALS transporting agency</td>
<td>8</td>
</tr>
<tr>
<td>Urban</td>
<td>Low</td>
<td>City</td>
<td>Fire-based, ALS/ BLS transporting agency</td>
<td>4</td>
</tr>
<tr>
<td>Suburban</td>
<td>High</td>
<td>Township</td>
<td>Fire-based, ALS transporting agency</td>
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</tr>
<tr>
<td>Rural</td>
<td>High</td>
<td>County</td>
<td>Governmental 3rd Service, ALS transporting agency</td>
<td>5</td>
</tr>
<tr>
<td>Rural</td>
<td>Intermediate</td>
<td>Multi-municipality</td>
<td>Governmental 3rd Service, ALS transporting agency</td>
<td>6</td>
</tr>
</tbody>
</table>
**Key Informant Interview and Focus Group Participant Recruitment**

At each site we asked the point of contact, usually an administrator responsible for entering data into the CARES registry, for assistance with identifying interview and focus group participants from 911/dispatch, non-transport fire, police, and the ED in that community. For key informant interviews, we recruited leadership, mid-level management, providers, and champions from each agency identified by administrators. For focus groups, we recruited 10–12 providers representing various parts of the emergency response system, such as 911 call takers, dispatchers, fire fighters, patrol and field police officers, paramedics, emergency medical technicians, and ED nurses. The focus group participants were primarily boots-on-the-ground or frontline key stakeholders. They were specific to the same geographic system of care and were participants within the surrounding community of the transporting EMS agency. Both interviews and focus groups covered the same topics. However, during focus groups, facilitators encouraged discussion among participants where appropriate and possible.

**Conducting the Interviews and Focus Groups**

A total of 88 key informant interviews and nine focus groups were conducted. There were more than 160 participants. The key informant interviews and focus groups were conducted at each site by research team personnel with experience in qualitative interviewing, cardiology, emergency medicine, and prehospital care. The key informant interview guide consisted of stakeholder-specific questions (e.g., for dispatch, police, non-transport fire, and EMS) to explore in depth the stakeholder-specific factors associated with OHCA care delivery (Table A.2). The development of the interview guide was informed by an evaluation of existing models of prehospital care for OHCA (e.g., Resuscitation Academy, 2020; see Husain and Eisenberg, 2013), input from content experts on our study team, and through building on our codebook from focus groups and interviews conducted with Michigan medical control authorities in prior work (Abir, Forman, et al., 2021). Domains covered were organizational characteristics, leadership, administrative support, care delivery strategies, QI practices, and stakeholder relationships. Interviews were approximately one hour in duration; focus groups lasted two hours. We piloted this interview guide at one emergency system site visit to refine the guide prior to conducting the rest of the site visits.

For each in-depth interview and focus group, one researcher primarily conducted the interview while the other served as a notetaker and facilitated audio recording. All interviews began with general, open-ended questions about respondents’ typical experience with OHCA response at their respective sites. We then asked questions focused on OHCA-related initiatives, such as a description of specific challenges, surprises, and successes in implementing change in their agency’s practices and procedures regarding OHCA. In addition, we asked respondents about their experiences with components associated with QI efforts. Finally, respondents were asked questions about communication and each agency’s culture to understand the organizational
environment and relationships with other emergency response groups. All interviews were audio recorded and professionally transcribed. The EPOC study was reviewed and approved by the University of Michigan Institutional Review Board.

<table>
<thead>
<tr>
<th>No.</th>
<th>Question</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Recall the last challenging cardiac arrest that you were involved in. What went well? What went wrong or could have gone wrong? (Reminder: Get the perspective of all participants)</td>
</tr>
<tr>
<td>2</td>
<td>What are some challenges in interacting with dispatch during cardiac arrest response? (Probe: How do you deal with these challenges?) What challenges may arise in getting bystanders to initiate CPR? (Probe: How do you deal with challenges?)</td>
</tr>
<tr>
<td>3</td>
<td>What challenges arise in arrival of first responders? (Probe: How do you deal with challenges?)</td>
</tr>
<tr>
<td>4</td>
<td>What challenges arise in care coordination and transitions between bystanders and first responders? Between police and non-transport Fire or EMS? Between non-transport Fire and EMS? Between EMS and hospitals? (Probe: How do you deal with these challenges?)</td>
</tr>
<tr>
<td>5</td>
<td>What helps a smooth transition between these responding entities?</td>
</tr>
<tr>
<td>6</td>
<td>Who else in your community influences response to cardiac arrest? How is their influence helpful? In what ways might it not be helpful?</td>
</tr>
<tr>
<td>7</td>
<td>Within your organization, what changes could be made to improve cardiac arrest outcomes? Are there formal training programs or requirements targeted to cardiac arrest?</td>
</tr>
<tr>
<td>8</td>
<td>How does the culture of your organization influence how it responds, or its ability to remove its response, to the cardiac arrests in the community? How about the culture of other organizations that respond to cardiac arrests in the community?</td>
</tr>
<tr>
<td>9</td>
<td>What characteristics in leadership within your organization are most conducive to fostering successful cardiac arrest response?</td>
</tr>
<tr>
<td>10</td>
<td>I want you to think about different policies for response of your organization and others in the community to cardiac arrest over the past 3–5 years. What policies have been helpful? What policies have been a hindrance?</td>
</tr>
<tr>
<td>11</td>
<td>How could changes to local and state policy improve cardiac arrest response?</td>
</tr>
<tr>
<td>12</td>
<td>What are three factors indispensable to effective cardiac arrest response in your community?</td>
</tr>
<tr>
<td>13</td>
<td>If you had a wish list to improve cardiac arrest response in your community, what three things would be on the list?</td>
</tr>
<tr>
<td>14</td>
<td>If you had to give three pieces of advice to a community looking to improve their cardiac arrest response rates, what would those be?</td>
</tr>
</tbody>
</table>

**Analyzing the Key Informant Interview and Focus Group Transcripts**

All transcripts were reviewed for quality and subsequently de-identified (blinded using code identifiers) for analysis so that the specific emergency response systems visited could not be identified.

We used a qualitative content analysis approach, followed by a matrix analysis, to conduct within- and cross-site analyses and develop findings. Analysis team members consisted of six
qualitative researchers. For each site, the team reviewed the key informant interview and focus group transcripts to identify themes. We used a preliminary taxonomy of factors as a priori codes and conducted an inductive analysis to refine our coding scheme. To understand each site and health care delivery system, members of the study team independently reviewed the transcripts for the first two sites applying a priori codes and using the constant comparative method to iteratively develop and refine codes and their definitions. Once there was agreement on codes, two to three coders coded the same transcripts until 80-percent agreement was reached. Remaining transcripts were then coded individually by two to three coders using MaxQDA software. All transcripts were coded with the final codes. We ran code reports for each site using MaxQDA software. With a focus on OHCA as a system of care across the chain of survival, and through review and discussion of the code reports, we developed site- and link-specific summary templates. Each member of the study team then created summaries for two or three sites, with iterative refinement by a team of five analysts. One team member familiar with all site data reviewed all completed templates for consistency. Strategies were extracted from these templates by two researchers.

The system-of-care qualitative analysis contained data, including summary statements and excerpts, relevant to each link in the chain of survival. The data had different tags or codes associated with various stakeholder-specific and system-of-care themes. On retrieval of all information from the system-of-care analysis that could be proposed as a strategy, two researchers reviewed the data and categorized each strategy as a stakeholder-specific strategy or a strategy applicable to the system of care. The strategies were subsequently refined and, from all the excerpts available, exemplary quotes were selected. Furthermore, one research team member with a background in prehospital care and research consolidated these qualitative findings into incident-level, stakeholder-level, system-level and change management strategies.

One of the approaches we used to identify best practices was a comparison of the high-performing and low-performing emergency medical systems that we visited. The research team started with site visits to both types of sites. Upon completing these site visits, we looked across the interview and focus group transcripts to see what high-performing systems did (and, conversely, low-performing systems did not do). These comparisons helped identify promising OHCA response strategies, especially those that were noted as important for success in high-performing sites and absent in low-performing sites. Promising practices were also identified in low-performing sites, particularly where they address important barriers to high performance, and some informed the recommended strategies in this report. The two intermediate performing systems were in rural areas with some creative solutions to OHCA response in the setting of poor resources.

Mixed Methods Integration

The quantitative data provided a means to select high- and low-performing systems. This framing proved invaluable for identifying detailed practices through individual interviews and
focus group interviews that provided a boots-on-the-ground perspective. Integration of the findings was achieved using a weaving approach to presentation of the report findings with qualitative quotes illustrating the key points. Furthermore, data from the literature review was used to describe current knowledge of qualitative findings in the literature.

Literature Review

The project team conducted a review of external literature to determine how the findings of our study interface with the current academic knowledge on the varied issues across the system of care for OHCA.

The project literature review consisted of a review of peer-reviewed literature using Scopus and of gray literature incorporating a targeted review of Kennedy Think Tank and Google websites (Table A.3). The literature review included a search strategy for all available information published in English from February 2010 through February 2022. Our search strategy used terms that would help capture literature on each of the responders’ roles in OHCA response, the influence on cardiac arrest survival and resuscitation performance, strategies, common pitfalls, and associated costs. Additional search terms intended to capture community education on OHCA, community education on hands-only CPR, community interfacing with 911, community education on first-responder roles, streamlining 911 calls, standard dispatch protocols, training protocols for first responders and dispatch on OHCA, standards of medical emergency 911 calls receipt and processing, quality assurance and audit of OHCA calls, implementation of continuous quality improvement, required technology and resources for first responders, successful transition of care, role of the ED, and relationships between responders. We reviewed qualitative, quantitative, and interventional studies but excluded efficacy trials, preclinical trial research, and health economics studies. One researcher conducted an initial review of titles to remove articles irrelevant to OHCA, then a team of six proceeded with the same approach while reviewing abstracts, and finally the full text to extract relevant information.

Four sequential steps were followed by the team of six researchers: (1) develop search strategies and scan the literature; (2) conduct citation tracking for the identified literature; (3) review literature, scan, and compile relevant findings; and (4) revise and reorganize findings by theme and stakeholder. The literature search was designed to support the proposed OHCA response strategies distilled from the qualitative data, including to inform the feasibility of implementing strategies (e.g., cost of buy-in from stakeholders) and long-term sustainability.

It is important to note that this literature review was not intended to be formal or systematic. Rather, it was designed to be a rapid analysis of relevant studies related to OHCA within the past decade that might inform the EPOC report strategies. The study was approved by the institutional review boards at the University of Michigan and the RAND Corporation.
Table A.3. EPOC Report Literature Review Search Strategy

<table>
<thead>
<tr>
<th>EPOC Report Literature Review Strategy Category</th>
<th>EPOC Report Literature Review Search Strategy</th>
</tr>
</thead>
<tbody>
<tr>
<td>For each strategy, we attempt to answer the following three questions:</td>
<td></td>
</tr>
<tr>
<td>• What literature advocates this strategy?</td>
<td></td>
</tr>
<tr>
<td>• Is there any literature that contradicts this strategy?</td>
<td></td>
</tr>
<tr>
<td>• What are the strategies and common pitfalls?</td>
<td></td>
</tr>
<tr>
<td>All Google search strategies will include the following to assess cost/price feasibility for each recommendation:</td>
<td>OR (&quot;cardiac arrest&quot;) AND (&quot;cost&quot;) OR (&quot;price&quot;)</td>
</tr>
</tbody>
</table>

**Educating on sudden cardiac arrest**

Google:

- Concept: Public Awareness
  "public awareness"
- Concept: Cardiac Arrest
  "cardiac arrest"

Scopus:

- Concept: Public Awareness
  (TITLE-ABS-KEY (bystander) OR TITLE-ABS-KEY (community) OR
  TITLE-ABS-KEY (public)) AND (TITLE-ABS-KEY (awareness) OR
  TITLE-ABS-KEY (education))
- Concept: Cardiac Arrest
  (TITLE-ABS-KEY (ohca) OR TITLE-ABS-KEY ("out-of-hospital
  cardiac arrest") OR TITLE-ABS-KEY (cardiac AND arrest))

**Educating on interfacing with 911/dispatch**

Google:

- Concept: Educating the Public on How to Use 911/Best Practices in 911 Public Education
  ("911" OR "9-1-1") AND ("public education" OR "public awareness")

Scopus:

- Concept: 9-1-1
  (TITLE-ABS-KEY (9-1-1)) OR TITLE-ABS-KEY (psap) OR TITLE-ABS-KEY ("public safety answering point") OR TITLE-ABS-KEY ("emergency communication* center") OR TITLE-ABS-KEY (telecommunicator) OR TITLE-ABS-KEY ("emergency dispatch*") AND NOT TITLE-ABS-KEY ("prosaposin")] AND
  NOT TITLE-ABS-KEY (9-1-1 complex)
- Concept: Public Education
  (TITLE-ABS-KEY ("public education") OR TITLE-ABS-KEY ("public awareness"))

Kennedy

- Concept: 9-1-1
  ("911" OR "9-1-1")
- Concept: Public Education
  ("public education" OR "public awareness")
<table>
<thead>
<tr>
<th>EPOC Report Literature Review Strategy Category</th>
<th>EPOC Report Literature Review Search Strategy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Educating on first responder roles</td>
<td>Key words: police, firefighter, fire fighter, fire department, fire authority, paramedic, emergency medical technician, EMT, E.M.T., police officer, trooper, deputy, deputies, public education, community relations, community policing, public relations</td>
</tr>
</tbody>
</table>

Google

- Concept: Medical Care
  - "Medical Response"

  AND
  - Concept: Public Perception of First Responders
    - (“public awareness” OR “public education” OR “media campaign” OR “public relations”) AND (“emergency services” OR “first responders”) site:.org
    - (“public awareness” OR “public education” OR “media campaign” OR “public relations” OR “public perception”) AND (“emergency services” OR “first responders”) site:.gov
    - (“public awareness” OR “public education” OR “media campaign” OR “public relations” OR “public perception”) AND (“emergency services” OR “first responders”) site:.edu
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    - (“public awareness” OR “public education” OR “media campaign” OR “public relations”) AND (“emergency services” OR “first responders”) site:.ems1.com
    - (“public awareness” OR “public education” OR “media campaign” OR “public relations”) AND (“emergency services” OR “first responders”) site:.police1.com
    - (“public awareness” OR “public education” OR “media campaign” OR “public relations”) AND (“emergency services” OR “first responders”) site:.firerescue1.com

Scopus

- Concept: First Responder
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  AND
  - Concept: Public Perception
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  AND
  - Concept: Medical Care
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<th>EPOC Report Literature Review Search Strategy</th>
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<td><strong>AND</strong></td>
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<td>Concept: Cardiac Arrest</td>
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<td>&quot;cardiac arrest&quot;</td>
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<td><strong>Kennedy</strong></td>
<td><strong>AND</strong></td>
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<td>Concept: Medical Care</td>
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<td><strong>AND</strong></td>
<td><strong>AND</strong></td>
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<td>Concept: Cardiac Arrest</td>
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<td>&quot;cardiac arrest&quot;</td>
<td>&quot;cardiac arrest&quot;</td>
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<td>Instituting centers to provide simulation-based training and introduction to emerging technologies and therapies</td>
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| Scopus                                        | Concept 1: Public Safety  
(TITLE-ABS-KEY ("public safety")) OR (TITLE-ABS-KEY (emergency AND medical AND services) AND TITLE-ABS-KEY (police) AND TITLE-ABS-KEY (fire)) AND Concept 2: CQI  
(TITLE-ABS-KEY ("continuous quality improvement") OR TITLE-ABS-KEY ("quality assurance") OR TITLE-ABS-KEY ("quality improvement") OR TITLE-ABS-KEY (debrief*)) AND Concept 3: Collaboration  
(TITLE-ABS-KEY (collaborat*) OR TITLE-ABS-KEY (joint) OR TITLE-ABS-KEY (combin*) OR TITLE-ABS-KEY ("multidisciplinary") OR TITLE-ABS-KEY ("interdisciplinary")) AND Concept 4: Cardiac Arrest  
(TITLE-ABS-KEY ("out of hospital cardiac arrest") OR TITLE-ABS-KEY (ohca) OR TITLE-ABS-KEY ("out-of-hospital cardiac arrest") OR TITLE-ABS-KEY ("cardiac arrest")) |
| Spending a day in the other person's shoes    | Google  
Concept: Public Safety Ride-Along  
"Perspectives" AND "ride-along" AND "public safety" AND Concept: Police Ride-Along  
"police ride alongs with fire" |
| Promoting an organizational collaborative culture | Google  
Concept: Promoting Organizational Collaboration  
"EMS" AND “Transitions of CARE” AND “cardiac arrest” |
| Improving transitions of care                 | Scopus  
Concept: EMS  
(TITLE-ABS-KEY ("EMS")) AND Concept: Transitions of Care  
(TITLE-ABS-KEY ("Transitions of Care")) |
| Identifying an EMS system champion            | Google  
Concept: EMS  
"emergency medical services" |

105
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Abbreviations

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<tr>
<td>ACLS</td>
<td>advanced cardiovascular life support</td>
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<tr>
<td>AED</td>
<td>automatic external defibrillator</td>
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<td>AEMT</td>
<td>advanced emergency medical technician</td>
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<td>AHA</td>
<td>American Heart Association</td>
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<td>ALS</td>
<td>advanced life support</td>
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<td>BLS</td>
<td>basic life support</td>
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<td>BVM</td>
<td>bag-valve-mask</td>
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<td>CAD</td>
<td>computer-aided dispatch</td>
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<td>CARES</td>
<td>Cardiac Arrest Registry to Enhance Survival</td>
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<td>CPR</td>
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<td>ETI</td>
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<td>ITD</td>
<td>impedance threshold device</td>
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<td>LALS</td>
<td>limited advanced life support</td>
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<td>Medical Priority Dispatch System</td>
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<td>telecommunicator CPR</td>
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AHA—See American Heart Association.


Brooks, Jesse, Samantha C. Friedrichsen, and Peter M. Nalin, “Quality of Handoffs from Emergency Medical Services to Emergency Department Providers,” *JEMS*, April 27, 2021.


CARES—See Cardiac Arrest Registry to Enhance Survival.


Center for Public Management, Maxine Goodman Levin College of Urban Affairs, Cleveland State University, *Case Studies for Consolidated Dispatch Center Feasibility Study: The Next Steps*, Cleveland, Ohio, 2011.


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