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# Initial Development of a Tool to Measure Implementation of Community Change to Improve Out-of-Hospital Cardiac Arrest

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## Abstract

***Background:*** *The Resuscitation Academy (RA) is a training and community change program to assist communities in implementing activities to improve survival after out-of-hospital cardiac arrest. The purpose of this paper is to present data on the development of an implementation index to measure community progress in achieving survival reduction.*

***Methods:*** *Community representatives who attended the RA in Seattle, WA (n=258) completed an on-line survey asking about achievement of the chain of survival program components, presented in the RA, and the most helpful things that supported communities in implementing these activities. Survival data in the Cardiac Arrest Surveillance (CARES) database was used to examine the association between implementation of chain of survival components and cardiac arrest survival rates in those agencies participating CARES.*

***Results:*** *The15-item scale was easily implemented in online form. Internal consistency, measured by an alpha coefficient, was 0.78. Time since RA participation was significantly related to implementation index score, indicating potential to measure change. An overall implementation index showed a positive association with independently measured survival ($p < 0.001$).*

***Conclusions:*** *These data indicate that the implementation index has acceptable properties for measuring community change in the area of implementation of cardiac survival efforts. Areas for improvement include further work on measurement and documentation of the implementation process in communities, and considering tailored feedback using the tool as way of providing assistance for communities struggling to implement this program.*

**Keywords:** *Cardiac arrest clinical, community collaboration process measures, Implementation cardiac survival clinical, community interface*

**Abbreviations:** *CPR: Cardiopulmonary Resuscitation; RA: Resuscitation Academy; QA: Quality Assurance; T-CPR: Telecommunicator-assisted CPR; OHCA: Out of Hospital Cardiac Arrest; CARES: Cardiac Arrest Registry to Enhance Survival; AED: Automatic External Defibrillator*

## Introduction

Approximately 350,000 people in the United States experience an Out-of-Hospital Cardiac Arrest (OHCA) each year [1,2] and most of these are sudden, unexpected, and result in death [1,3]. Average survival rates are reported between 8% [4,5] and 10% [2] with considerable variance across geographic settings [3,5-8]. Survival is determined, in large part by a community's ability to respond promptly to a cardiac crisis.

The "chain of survival" is a metaphor for the sequence of interventions that are required in a successful resuscitation [3,9] (Table 1). After a patient collapses, loses consciousness, and ceases to breathe. timely delivery of interventions is critical [3,10-12] and begins with early access to the emergency calling (9-1-1) system. Use of rapid dispatch protocols (to reduce the time it takes to get medical personnel to the scene), the practice of sending the proper medical personnel before all the information has been obtained by the dispatcher from the caller, can save up to a minute, sometimes more in the delivery of vital care [3].

Rapid provision of Cardiopulmonary Resuscitation (CPR) (within four minutes) improves the potential for survival by slowing the dying process during the time that defibrillation and advanced care is not yet present [3,4,10-13]. In some communities 911 telecommunicators provide bystanders with "just-in-time" telephone-assisted CPR instructions (T-CPR) over the phone, which is credited with substantially improving survival from cardiac arrest [4,14,16-20]. As such, the presence of a high quality T-CPR program that includes prompt identification of the need for T-CPR and provision of instructions to the caller is an essential component of the chain of survival [21-23]. Quality of prehospital activities has been related to improved outcomes of cardiac arrest [3,24-30]. As such Quality Assurance (QA) activities are an integral part of success in optimizing the chain of survival in communities [3,28-31]. Several prospective single community case studies report that simultaneous improvements in multiple links of the chain of survival, as well as implementation of continuous QA activities, are associated with increased survival rates [5,32-38].

| Intervention | Impact on survival | Agency or system |
|---|---|---|
| Rapid dispatch protocols | To reduce time to emergency response | 9-1-1 dispatch centers |
| Training 9-1-1 dispatchers in Telephone-assisted CPR (T-CPR) and in starting T-CPR instructions within 4 minutes of start of 9-1-1 call | To increase bystander CPR rates | 9-1-1 dispatch centers |
| Community CPR training programs | To increase bystander CPR rates | Community organizations |
| Training EMS providers in High performance CPR (HP-CPR) | To increase quality of resuscitation efforts by first responders | EMS agencies (fire departments; paramedics) |
| First responder Automated External Defibrillation (AED) programs | To reduce the time to delivery of an electrical shock by AED | EMS agencies |
| Police AED program | To reduce the time to delivery of an electrical shock by AED | Police agency |
| Public Access Defibrillation programs | To reduce the time to delivery of an electrical shock by AED | Community |
| Cardiac Arrest Surveillance (CARES) | To measure and improve | 9-1-1 dispatch, EMS agencies, hospitals |
| Quality Assurance programs for T-CPR, HP-CPR and CA review | To measure and improve | 9-1-1 dispatch, EMS agencies, |

***Table 1.*** *Evidence-based interventions related to the chain of survival*

In response to these studies, emergency medical services leaders from King County WA developed a 2-day conference/workshop to help other communities implement the evidence and practice of OHCA to communities outside of King County, WA starting in 2009.This effort was named "the Resuscitation Academy" (RA, www.resuscitationacademy.org). This 2-day workshop brings together community EMS leaders to learn about the actions necessary to reduce death from cardiac arrest, delivered in training programs that are developed based on the strongest evidence on different pre-hospital resuscitation protocols as well as guidelines by the American Heart Association [24,25]. Since its inception, RAs have been developed and implemented in other U.S. states and several other countries, including European, and there are currently efforts underway to expand this effort globally [37-39]. In addition, 79-page Resuscitation ebook was developed targeted at emergency medical personnel, particularly medical directors and managers and administrators that include resources needed to develop an RA at the local level or implement RA activities in a community [40].

However, there are no data reporting the process of evaluating the implementation of the RA activities. Indeed, there are no measures to track implementation across time and across communities, to better understand the variations in success and to help communities consider and act on their successes and challenges. The purpose of this paper is to present data on the development of an implementation index to measure community progress in achieving its survival improvement goals.

## Methods

### Study design and population

Data for this project come, in part, from The Heart Rescue Project, a large US initiative which aims to develop regional cardiac resuscitation systems of care that implement guideline-based best practice bystander, pre-hospital and hospital care [41-45]. As a way to achieve this goal, the Resuscitation Academy was established by Emergency Medicine faculty and staff at the University of Washington and facilitated by experts in each of the areas of improvement. Community leaders such as EMS medical directors and trainers, from different communities around the region are invited to attend. By design, the attendance of each RA is capped at 40 persons. This allows a forum for the whole group to participate in discussion on various topics. Breakout sessions typically range from 5-10 persons, allowing for in-depth mentoring and support during road blocks. The content of the 2-day event held in Seattle includes Telecommunicator-assisted CPR (T-CPR), high performance CPR by first responders (HP-CPR), and community programs related to public access defibrillation and community CPR training. Each RA includes hands-on sessions with topics on data collection, HP-CPR and T-CPR, QA review of cardiac arrest events, and strategies for raising funds to support improvement efforts. These sessions are designed to give attendees a chance to practice skills, learn in-depth strategies for implementation, and discuss details of programs with the experts.

Survey Design and Administration

We realized that in order to track progress in implementing the activities of the RA, we would need to provide communities with an easy-to-use quantifiable measure of implementation for the key activities learned in the RA. Therefore, we used existing resources and personnel to define the key activities of the chain of survival, and drafted questions about each one. The survey included 15 questions, each targeting one of the activities in table 1. We selected a dichotomous scale (yes/no) for each item to keep the survey simple and quick to complete. We piloted the survey with colleagues in communities who had participated in the RA and in community change previously.

We administered this on-line survey with RA alumni to assess self-reported changes in the links of the chain of survival from pre- to post- RA attendance (See supplemental materials for a

copy of the survey). We sent the survey link to emails recorded from those who attended RA from July 1, 2008 to July 1, 2014, a total of 543 email attendees from 274agencies.We selected this period because it encompasses the beginning of the RA and the time that another group at the University of Maryland began offering an RA. We received 258 nonfunctioning email returns (eg, no longer employed here, nonfunctioning address), leaving us with 285 functional emails. From these we received 168 responses for a response rate of 59%. Responses from agencies outside of North America or agencies not involved directly in EMS activities were excluded from analysis (n=17). This study was judged as exempt by the Human Subjects Committee of the University of Washington. All participants (including multiple respondents from a single site) provided verbal consent to collect the survey data and to publish without identifiers.

In this survey we inquired about implementation of a series of activities that comprise the chain of survival, as shown in table 1. For each item, we asked about presence or absence of the individual chain-of-survival components before the RA, and also about present day, post RA attendance. In addition to implementation of key activities, we asked about the most helpful resources for assistance in implementing these components using a four- point scale. Finally, we asked each respondent what type of agency they were employed by and what their job title was. We reminded the potential respondents up to three times, by email, to complete the survey.

| At time of survey | | |
|---|---|---|
| | **N agencies** | **proportion present** |
| Rapid Dispatch | 93 | 0.78 |
| T-CPR | 96 | 0.97 |
| Public education CPR | 96 | 0.91 |
| Training first responders in HP-CPR in cpr | 96 | 0.95 |
| First responders AED | 95 | 0.93 |
| Police AED program | 92 | 0.49 |
| Public access AED program | 93 | 0.76 |
| CARES enrollment | 93 | 0.84 |
| QA for T-CPR | 92 | 0.7 |
| T-CPR within Four Minutes | 82 | 0.85 |
| QA for high performance CPR | 91 | 0.77 |
| QA for Cardiac arrests | 94 | 0.86 |

***Table 2.*** *Self-reported implementation rates of chain of survival program component among RA alumni*

| **Time since attending RA** | **< 1 year** | **1 year** | **2 years** | **>2 years** |
|---|---|---|---|---|
| N agencies | 23 | 17 | 19 | 37 |
| % | 0.24 | 0.18 | 0.2 | 0.39 |
| | Proportion implemented | | | |
| 1. Rapid Dispatch | 0.55 | 0.84 | 0.81 | 0.87 |
| 2. T-CPR | 0.91 | 0.95 | 1 | 1 |
| 3. Public education CPR | 0.8 | 0.89 | 0.95 | 0.96 |
| 4. Training first responders in HP-CPR | 0.85 | 0.94 | 0.97 | 1 |
| 5. First responders AED | 0.83 | 0.97 | 0.9 | 1 |
| 6. Police AED program | 0.36 | 0.67 | 0.4 | 0.52 |
| 7. Public access AED program | 0.55 | 0.67 | 0.9 | 0.85 |
| 8. CARES | 0.76 | 0.79 | 0.88 | 0.89 |
| 9. QA for T-CPR | 0.34 | 0.79 | 0.86 | 0.79 |
| 10. T-CPR within Four Minutes | 0.73 | 0.9 | 0.79 | 0.96 |
| 11. QA for high performance CPR | 0.5 | 0.8 | 0.95 | 0.8 |
| 12. QA for Cardiac arrests | 0.59 | 0.86 | 0.95 | 0.99 |

***Table 3.*** *Association betweenimplementation rates and time since attendance at the Resuscitation Academy*

### Data analyses

Analysis of the survey measure was conducted on responses from all North American agencies involved in EMS activities. We calculated an implementation index by summing the responses from all 12 items into a single score, where for each element 1=performing that activity and 0=not performing that activity. We reviewed the integrity of the scale by calculating internal consistency (Cronbach's alpha) of the scores, and overall mean percentage agreement between item responses between all unique pairs of participants who attended from the same agency. We then calculated the proportion of program activities implemented for each agency, averaging responses over participants from the same agency. Validity was assessed in two ways. First, we calculated the length of time since attending the RA and number of activities performed, reasoning that a measure taken after varied time since exposure to the RA would allow for more time to implement. Second, we related the relationship between implementation of activities post attendance and cardiac arrest survival to hospital discharge was analyzed in the subset of agencies whom had joined CARES and provided data into CARES, for the years 2012-2014 using logistic regression with quasi-binomial family with survival to hospital discharge as the outcome variable. Outcomes (survival/no survival) were linked to agency by the community served by each agency. All statistical analyses were conducted in R3.3.1. Data are available through a publically available database management system.

We were able to assess validity of the measure in two ways, by first relating each item in the new measure to overall survival rates in the CARES database, and two, by independently verifying the validity of each item in the measure through a separate telephone call to a subsample of five communities. We report data on both methods of estimating validity.

## Results

A total of 53.1% of respondents (n=153) worked for an EMS agency, while 46.2% worked at a fire agency and less than 1% worked at a police agency. Job titles of the respondents varied, with 30% reporting as medical directors or equivalent, 59% reporting another leadership role, and 11% reporting other job positions. The survey took an average of 12 minutes to complete. Median time to complete the online survey was 12 minutes. No participants skipped any items, but some (10%) referred the interviewer to other people in the community in order to obtain an accurate answer. The implementation index had high internal consistency, as evidenced by an alpha coefficient of 0.78 for the entire scale.

The implementation rates for key elements (Rapid dispatch, enrollment in CARES, implementation of T-CPR, meeting four minute target for starting T-CPR, high performance CPR, and cardiac arrest review, Automatic External Defibrillator (AED) programs for First responders and police, public access AED programs, and public education and training in CPR) are presented in table 2.The results show that implementation of a police AED program was least likely to be reported whereas implementation of a Telephone-assisted CPR dispatch program was most frequently implemented, reflecting the emphasis given to T-CPR during the 2-day training program.

In general, implementation rate varied by length of time since attending the RA, as shown in table 3. Statistically significant increases in implementation rate with time since attendance were observed for Rapid dispatch, T-CPR, Public access AED's, Public Education, T-CPR within four minutes, QA-T-CPR, QA-High Performance and QA-CA. The rate of increase for QA-T-CPR and QA-high performance CPR leveled off after the 1 year mark, while for Rapid dispatch, T-CPR, Public access AED's, Public Education, T-CPR within four minutes and QA-CA the rates continued to increase. The overall proportion of elements implemented was also positively associated with time since attending RA ($p < 0.01$).

| **Overall Survival** | | | | |
|---|---|---|---|---|
| | Odds ratio | log odds | se | p |
| All elements combined | 2.48 | 0.91 | 0.3 | 0.005 |
| Program elements combined | 2.89 | 1.06 | 0.34 | 0.004 |
| QA elements combined | 1.73 | 0.55 | 0.29 | 0.07 |
| **Program Elements** | | | | |
| Rapid Dispatch | 1.42 | 0.35 | 0.3 | 0.005 |
| T-CPR | 1.8 | 0.59 | 0.39 | 0.145 |
| High Performance CPR | 0.38 | -0.98 | 0.86 | 0.266 |
| T-CPR within Four Minutes | 1 | 0 | 0.33 | 0.991 |
| First responders AED | 2.05 | 0.72 | 0.42 | 0.1 |
| Police AED program | 1.21 | 0.19 | 0.11 | 0.084 |
| Public access AED program | 1.43 | 0.36 | 0.14 | 0.014 |
| Public education/training CPR | 1.55 | 0.44 | 0.28 | 0.122 |
| **Quality Assurance Programs** | | | | |
| QA for T-CPR | 1.35 | 0.3 | 0.18 | 0.098 |
| QA for high performance CPR | 1.28 | 0.25 | 0.18 | 0.178 |
| QA for Cardiac arrests | 1.74 | 0.55 | 0.33 | 0.101 |

***Table 4.*** *Odds of CA survival associated with the different interventions reported post RA related to successful out-of-hospital resuscitation for the 36 agencies in the study participating in CARES.*

| Survey Question | Validation Checklist and Interview Guide | Agreement? #/5 |
|---|---|---|
| Is your agency enrolled in the Cardiac Arrest Surveillance registry (CARES)? | Check CARES database, is this agency enrolled? | 5/5 |
| Does your agency have a rapid dispatch system in place? | Provision of a protocol for quickly identify a medical emergency and dispatch as quickly as possible? | 2/5 |
| Does your agency have a dispatcher-assisted CPR program in place? | Provision a protocol for review | 4/5 |
| Is regular quality assurance being performed to monitor dispatcher assisted CPR? | Independent verification by another person of QA activities | 2/5 |
| If yes: Is this performance being reported to the agency for improvement? | Provision of a report created for the agency | 1/5 |
| Does your agency meet the goal of having an average phone pick up time to onset of CPR instructions less than 4 minutes? | Identification of the average time is for how quickly dispatch will administer telephone CPR | 2/5 |
| Do first responders in your agency receive high performance CPR training? | Provision of the protocol and documentation of trainings that first responders receive for high performance CPR | 4/5 |
| Is regular quality assurance being performed to monitor the quality of high-performance CPR in EMTs? | Description and schedule for how/when high performance CPR is reviewed | 5/5 |
| If yes: is this performance being reported to the agency for improvement? | Provision and schedule of the report of the high-performance CPR review data | 3/5 |
| Is there regular reporting of overall cardiac arrest survival data in your community to a larger governing body (city council, mayor's office, etc)? | Reports and presentations of agency to the mayor's office or city council about cardiac arrest survival data? | 3/5 |
| Do first responders in your agency carry Automatic External Defibrillators (AEDs)? | Provision of a list, including location, of these automatic external defibrillators: | 5/5 |
| Is there a program in place to train police officers on AED usage? | Schedule and list of trainings for police to use AEDs | 5/5 |
| Is there a public access defibrillation program in place in your agency? | List and locations of AEDs located in your community Independent verification of AED at location | 3/5 |
| Does your agency have a public CPR education/training program in place? | Protocol and list of public trainings for CPR use. | 3/5 |
| Is CPR training mandated in primary schools in your community? | List and protocol for trainings in middle and high school. Independent verification of traininings in schools | 4/5 |

***Table 5.*** *Validity measures for each question on survey.*

Validity was assessed in two ways, one, by relating the frequency of performing each component in the index, as well as the overall score, to survival as measured by the CARES data set. Table 4 shows the associations between program components and quality assurance programs, and cardiac arrest survival as measured in the CARES registry for the 36 agencies which participate in CARES. A total of 4958 cases were reported during the post-attendance period, with the number of per agency ranging from 3 to 991 (median 68, IQR 25 - 131); overall survival rates varied from 0% to 30.4% (mean 14.6, sd 6.6).Moderate within agency clustering was observed, with quasi-binomial dispersion parameter ranging from 1.4 to 1.8. The overall proportion of items implemented was related to cardiac survival from the registry. Each of the elements from the links in the Chain of Survival were positively associated with cardiac arrest survival, although these associations were not statistically significant. Most of the QA activities were significantly and positively related to survival in this table as well.

Validity was also assessed by recalling a random sample of five communities, to ask about independent validation of each item on the checklist. Table 5 shows the measure of validity collected for each survey measure and the number of communities that matched exactly their responses to the validity measure. The average percent agreement score for the survey-validation procedure was calculated to be 0.795 (range 0.714-0.928). This represents a moderate level of agreement and the range indicates that previous RA attendees are able to self report these measures with a moderate to high degree of accuracy

## Discussion

This manuscript presents data on the development and initial properties of an early version of an implementation index, as a measure of implementation of the key activities necessary to improve poor cardiac arrest survival rates in communities. Having this index enables future evaluations to quickly and easily evaluate progress toward improving survival at regular intervals as the program activities are being implemented. The tool took less than 15 minutes to collect over the Internet, and all participants found it easy to use and respond to. This means that it can be used repeatedly to track incremental progress, not just long-term change.

Measurement lags behind innovation in intervention in this field [46]; we need to pay attention to improving our implementation

measurement tools. The implementation index as used here had very high agreement among the items, as evidenced by the high alpha coefficient. It also showed reasonable validity with relationship to the key health outcome of the RA survival from out-of-hospital cardiac arrest. Given its easy administration plus high reliability and validity, this measure can serve as a short term outcome in studies to evaluate the RA as a public health tool for improving communities' abilities to improve cardiac survival. RA and its spin-off events are spreading throughout the country and evaluation becomes very important for wide-spread implementation. This implementation index will help future investigators quickly evaluate their progress in this implementation process in future studies.

As seen in these data, simple agreement about public events is not guaranteed among observers, which could lead to loss of statistical power to determine associations between implementation of program elements and survival due to underestimating of the magnitude of the association and increases in the estimate variability [47]. Understanding the best ways to report specific acts of implementation could improve the variance in this index and make for a better process measure of success for future research and practice. This is an active area of our research efforts. In addition, we will expand the response format to a multipoint scale, rather than a simple dichotomous answer to each question in the next implementation, due to difficulty experienced by several respondents in fitting their community progress into a yes or no answer.

Limitations in these data contribute to caution in interpreting the results. This is a new and untested field, without instruments that have been used in previous research on implementation processes. Any findings here must be confirmed in additional research with stronger designs and measurement properties. Recall bias might have influenced the reports of progress, and it will be essential to use and evaluate this index in a frequent and longitudinal fashion to reduce this bias.

These data are subject to all kinds of biases, and need replication and further validation to confirm these patterns. The sampling process lost individuals to follow-up through attrition, nonresponse, and other issues. The response rate was not high, and this limits our ability to generalize to all participating agencies about what might work or what communities might respond best to the RA intervention. As with other research, it is likely that some of these nonresponders were not performed at random, but represent potentially poor performers. However, people move among positions in this type of work, and so changing emails when work locations change is not unusual. This needs investigation as it is these poor performers that perhaps need more assistance and more rigorous follow-up. Other sources of unmeasured variation include other measurement issues, such as who best to assess progress at the community level and how to reconcile conflicting responses. These and other issues need further investigation.

## Conclusions

Our research showed the variance in program adoption after RA exposure. This may reflect differential levels of control community leaders have over program changes. Studying a number of communities' implementation of the RA provides a valuable opportunity to better understand the implementation process at the community level. Performance of some of the elements of the chain of survival grew over the two year period, while other elements changed in the first year, but did not continue to change. The reasons for this are currently unknown but could speak to the need to give communities adequate time to develop resources and change long-standing practices for this project.

This measure could also be used as a guide for developing tailored interventions to assist communities in changing elements identified during the RA to achieve high cardiac arrest survival rates. Repeated administration of the index over time could be used to show communities what they have accomplished, but also what they have still to change. Tailored feedback based on organizational self-assessment has been successfully used in several health program implementation studies [48,49]. Informal requests from RA attendees for this type of feedback have occurred at every RA session, so it is likely that tailored feedback will be well received.

### Ethical approval

Ethics approval and consent to participate. This study was judged as exempt by the University of Washington IRB.

**Consent for publication:** NA

### Availability of data and material

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

### Competing interests

The authors have no competing interests to report.


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### Declarations

Author contributions include:

DJB--study concept and design, acquisition of the data, analysis and interpretation of the data, drafting of the manuscript, critical revision of the manuscript for important intellectual content, statistical expertise

HM-- study concept and design, acquisition of the data, analysis and interpretation of the data, drafting of the manuscript, critical revision of the manuscript for important intellectual content, statistical expertise

IP-- study concept and design, acquisition of the data, analysis and interpretation of the data, drafting of the manuscript, critical revision of the manuscript for important intellectual content, statistical expertise

AD-- study concept and design, acquisition of the data, analysis and interpretation of the data, drafting of the manuscript, critical revision of the manuscript for important intellectual content, statistical expertise

TH-- study concept and design, acquisition of the data, analysis and interpretation of the data, drafting of the manuscript, critical revision of the manuscript for important intellectual content, statistical expertise

ME-- study concept and design, analysis and interpretation of the data, drafting of the manuscript, critical revision of the manuscript for important intellectual content, statistical expertise, acquisition of funding

## References


1. American Heart Association: About Cardiac Arrest. vailable on-line at http://www.heart.org/HEARTORG/Conditions/More/CardiacArrest/About-Cardiac-Arrest_UCM_307905_Article.jsp, accessed 9/12/2014.
2. McNally B, Robb R, Mehta M, Vellano K, Valderrama AL, et al. Out-of-Hospital Cardiac Arrest Surveillance – Cardiac Registry to Enhance Survival (CARES), United States, October 1, 2005-December 31, 2012; MMWR.2011; 60:1-19.
3. Eisenberg MS. Resuscitate. How Your Community Can Improve Survival from Sudden Cardiac Arrest. University of Washington Press. Seattle. 2009.
4. Sasson C, Rogers MAM, Dahl J, Kellerman AL. Predictors of survival from out-of-hospital cardiac arrest: a systematic review and meta-analysis. *Circulation Cardiovascular Quality and Outcomes.* 2010; 3: 63-81.
5. Ewy GA, Sanders AB. Alternative approach to improving survival of patients with out-of-hospital primary cardiac arrest. *J Am Coll Cardiol.* 2013;61:1130-1138.
6. Fosbol EL, Strauss B, Swanson DR, Myers B, Dupre ME, et al. Association of neighborhood characteristics with incidence of out-of-hospital cardiac arrest and rates of bystander-initiated CPR: implications for community-based education interventions. *Resuscitaiton*. 2014; S0300-9572 (14)00715-1. [Epub ahead of print].
7. Sasson C, Keirns CC, Smith D, Sayre M, Macy M, et al. Small area variations in out-of-hospital cardiac arrest: Does the neighborhood matter? *Ann Intern Med.* 2010; 153:19-22.
8. Nichol G, Thomas E, Callaway C, et al. Regional variation in Out-of-Hospital Cardiac Arrest incidence and outcome. *JAMA.* 2008;300:1423-1431.
9. Nolan J, Soar J, Eikeland H. The Chain of Survival. *Resuscitation.* 2006; 71:270-271.
10. Abrams HC, McNally B, Ong M, Moyer PH, Dyer KS. A composite model of survival from out-of-hospital cardiac arrest using the Cardiac Arrest Registry to Enhance Survival (CARES). *Resuscitation.* 2013;84:1093-108.
11. Stromsoe A, Afzelius S, Axelsson C, Sodersved Kallestedt ML, Enlund M, et al. Improvements in logistics could increase survival after out-of-hospital cardiac arrest in Sweden. *J Intern Med.* 2013; 273:622-627.
12. Kitamura T, Morita S, Kiyohara K, Nishiyama C, Kajino K, et al. Trends in survival among elderly patients with out-of-hospital cardiac arrest: a prospective, population-based observation from 1999 to 2011 in Osaka. *Resuscitation.* 2014; Aug 7 pii S0300-9572(14)000680-7. (Epub ahead of print)
13. Sasson C, Meischke H, Abella BS, Berg RA, Bobrow BJ, et al. Increasing cardiopulmonary resuscitation provision in communities with low bystander cardiopulmonary resuscitation rates. *Circulation*. 2013; 127: 1342-1350.
14. Sipsma K, Stubbs BA, Plorde M. Training rates and willingness to perform CPR in King County, Wahington: a community survey. *Resuscitation.* 2011; 82:564-567.
15. Tanigawa K, Iwami T, Nishiyama C, Nonogi H, Kawamura T. Are trained individuals more likely to perform bystander CPR? An observationsl study. *Resuscitation.* 2011;82:523-528.
16. Swor R, Khan I, Domeier R, Honeycutt L, Chu K, et al. CPR training and CPR performance: Do CPR-trained bystanders perform CPR? Academic Emergency *Medicine.* 2006;13:596-601.
17. Holmberg M, Holmberg S, Herlitz J. Effect of bystander cardiopulmonary resuscitation in out-of-hospital cardiac arrest patients in Sweden. *Resuscitation.* 2000;47:59-70.
18. Bang A, Herlitz J, Holmberg S. Possibilities of implementing dispatcher-assisted cardiopulmonary resuscitation in the community. An evaluation of 99 consecutive out-of-hospital cardiac arrests. *Resuscitation.* 2000;44:19-26.
19. Herlitz J, Svensson L, Holmberg S, Angquist KA, Young M. Efficacy of bystander CPR: Intervention by lay people and by health care professionals. *Resuscitation.* 2005;66:291-295.
20. Bobrow BJ, Panczyk M, Subido C. Dispatch-assisted cardiopulmonary resuscitation: the anchor link in the chain of survival. *Curr Opin Crit Care.* 2012;18:228-233.
21. Rea TD, Eisenberg MS, Culley LL, Becker L. Dispatcher-assisted cardiopulmonary resuscitation and survival in cardiac arrest. *Circulation.* 2001;104:2513-2516.
22. Berdowski J, Beekhuis F, Zwinderman AH, Tijssen JGP, Koster RW. Importance of the first link: description and recognition of an out-of-hospital cardiac arrest in an emergency call. *Circulation.* 2009;119:2096-2102.
23. Cave DM, Gazmuri RJ, Otto CW, Nadkarni VM, Cheng A, et al. Part 7: CPR techniques and devices: 2010 American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care. *Circulation.* 2010;122:720-728.
24. Rea TD, Helbock M, Perry S, Carcia M, Cloyd D, et al. Increasing use of Cardiopulmonary Resuscitation During Out-of-Hospital Ventricular Fibrillation Arrest. Survival Implications of Guideline Changes. Circulation. Available on-line at http://www.circulationaha.org 2006; 2760-2765, accessed September 10th, 2014.
25. http://eccguidelines.heart.org/wp-content/uploads/2015/10/2015-AHA-Guidelines-Highlights-English.pdf, accessed November 2016.
26. Richardson LD, Gunnels MD, Groh WJ, Peberdy MA, Pennignton S, et al. Implementation of community-based public access defibrillation in the PAD trial. *Acad Emerg Med*. 2005;12:688-697.
27. Litwin PE, Eisenberg MS, Hallstrom AP, Cummins RQ. The location of collapse and its effect on survival from cardiac arrest. *Ann Emerg Med.* 1987;16:787-791.
28. Nolan JP. High-quality cardiopulmonary resuscitation. Available on-line at: www.co-criticalcare.com. 2014; 20:227-233, accessed September 25th, 2014.
29. Aufderheide TP, Yannopoulos D, Lick CJ, Myers B, Romig LA, et al. Implementing the 2005 American Heart Association Guidelines improve outcomes after out-of-hospital cardiac arrest. *Heart Rhythm.* 2010; 7:1357-1362
30. Meany PA, Bobrow BJ, Mancini ME, Christenson J, de Caen AR, et al. CPR Quality Summit Investigators, the American Heart Association Emergency Cardiovascular Care Committee, and the Council on Cardiopulmonary, Critical Care, Perioperative and Resuscitation. *Circulation.* 2013; 128:417-435.
31. Bobrow BJ, Vadeboncoeur TF, Stolz L, Silver AE, Tobin JM, et al. The influence of scenario-based training and real-time audiovisual feedback on out-of-hospital cardiopulmonary resuscitation quality and survival from out-of-hospital cardiac arrest. *Ann Emerg Med.* 2013; 1-11.

32. Fothergill RT, Watson LR, Chamberlain D, Virdi GK, Moore FP, et al. Increases in survival from out-of-hospital cardiac arrest: a five year study. *Resuscitation.* 2013;84:1089-1092.

33. Moller NA, Lou ID, Knudsen LF, Rasmussen LS. Engaging a whole community in resuscitation. *Resuscitation*. 2012;83:1067-1071.

34. Lick CJ, Aufderheide TP, Niskanen RA, Steinkamp JE, Davis, SP, et al. Take Heart America: A comprehensive, community-wide, systems-based approach to the treatment of cardiac arrest. *Crit Care Med.* 2011; 39:26-33.

35. Becker L, Gold LS, Eisenberg M, White L, Hearne T, Rea T. Ventricular fibrillation in King County, Washington: a 30-year perspective. *Resuscitation.* 2008;79:22-27.

36. Neumar RW, Barnhart JM, Berg RA, Chan PS, Geocadin RG, et al. Implementation strategies for improving survival after Out-of-Hospital Cardiac Arrest in the United States; Consensus Recommendations from the 2009 American Heart Association Cardiac Arrest Survival Summit. *Circulation.* 2011; 123: 2898-2910.

37. European Resuscitation Academy, at http://www.resuscitationacademy.eu/downloads/Invitation_Ticino%202016_FINAL_07012016.pdf

38. 38.Medtronic Foundation. Resource Center, at http://www.heartrescueproject.com/resource-downloads/index.htm#resuscitation, accessed November 16, 2016.

39. A Call to Establish a Global Resuscitation Alliance at, http://www.resuscitationacademy.org/wp-content/uploads/2016/03/A-Call-to-Establish-a-Global-Resuscitation-Alliance1.pdf

40. Resuscitation Academy ebook. http://www.resuscitationacademy.org/index.php/ebook/,accessed September 12, 2016.

41. Van Diepen S, Abella BS, Bobrow BJ, Nichol G, Jollis JG, et al. Multistate implementation of guide-line based cardiac resuscitation systems of care: description of the HeartRescue project. *Am Heart J.* 2013; 166:647-653.

42. Damschroder LJ, Aron DC, Keith RE, Kirsh SR, Alexander JA, et al. Fostering implementation of health services research findings into practice: a consolidated framework for advancing implementation science. *Implementation Science.* 2009;4:1-15.

43. Greenhalgh T, Robert G, Macfalane F, Bruce P, Kyriakidou O. Diffusion of innovation in service organizations: systematic review and recommendations. *Milbank Q.* 2004;82:581-629.

44. Kitson A. From research to practice: one organizational model for promoting research-based practice. *EDTNA ERCA J*. 1997; 23:39-45.

45. Lewis CC, Weiner BJ, Stanick C, Fischer. Advancing implementation science through measure development and evaluation: a study protocol. *Implement Sci.* 2015;10:102.

46. Ogrinc G, Davies L, Goodman D, Batalden P, Davidoff F, et al. BMJ Qual Saf. 2015 Sep 14. SQUIRE 2.0 (Standards for Quality Improvement Reporting Excellence): revised publication guidelines from a detailed consensus process. Accessed November 30, 2016.

47. Andrew C (1991). "The effect of measurement error". *Biometrika.* 78: 451-462.

48. Hannon P, Harris JR, Sopher CJ, Kuniyuki A, Gosh DL, et al. Improving Low-Wage, Midsized Employers' Health Promotion Practices. A Randomized Controlled Trial. *Am J of Prev Med.* 2012;43:125-133.

49. Harris J, Cross J, Hannon P, Mahoney E, Ross-Viles S, et al. Employer Adoption of Evidence-Based Chronic Disease Prevention Practices: A Pilot Study. *Prev Chronic Dis.* 2008; 5:1-9.

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