Drs. Bobrow and Spaite are Co-Principal Investigators of the HeartRescue Project which is funded by Medtronic Philanthropy.
Statewide Implementation of a Standardized Pre-arrival Telephone-CPR Program Is Associated with Increased Bystander CPR and Survival from Out-of-Hospital Cardiac Arrest

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Background

- **Bystander-CPR (B-CPR)** doubles OHCA survival but is provided in only ~ 1/3 events ¹

- **Telephone-CPR (T-CPR)** has been independently associated with increased rates of B-CPR & survival ²

- Implementation of **T-CPR** varies widely and few centers measure performance ³

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1. Sasson 2010
2. Rea 2001; Tanaka 2012; Song 2014
3. Roosa 2014
Purpose

- To implement and measure the impact of a T-CPR bundle of care on patient outcomes and process metrics
Hypothesis

Implementing the 2012 AHA T-CPR guidelines would be associated with:

1. An increase in the frequency of T-CPR instructions
2. A reduction in time to first bystander compression
3. An increase in survival to hospital discharge and proportion with a CPC score of 1 or 2
Methods

- Prospective before/after interventional study (P1 vs. P2)

- 9-1-1 audio recordings of OHCAs (10/2010-10/2013) in 9 regional emergency dispatch centers were audited

- Recordings from P1 and P2 at three emergency dispatch centers in Maricopa County were linked to an Utstein-style OHCA database.
Statistical Methods

- Fisher’s exact test (categorical data) and median regression (continuous data) to compare T-CPR process data between P1 vs. P2

- Multivariable logistic regression to
  - Compare survival & CPC score (1 or 2) between P1 vs. P2
  - Test if T-CPR is independently associated with improved survival and favorable neurologic outcome

- Controlling for witnessed arrest, shockable rhythms, age, sex, OHCA location, therapeutic hypothermia, and secular trends

- Random effects models account for clustering by dispatch center

- Propensity score adjustment was used to reduce bias
Study Endpoints

- **Primary Endpoints**: Survival and CPC score (1 or 2)

- **Secondary Endpoints**: T-CPR Process Measures
Inclusion Criteria for Primary Endpoints: Survival and CPC

- All EMS-confirmed, treated OHCA events with data linked between 9-1-1 → EMS → Hospital
- Age > 8 years old
Inclusion Criteria for Secondary Endpoints:  \textit{T-CPR Process}

- All EMS confirmed, treated OHCA events with data linked between 9-1-1 $\rightarrow$ EMS $\rightarrow$ Hospital

- Age $> 8$ years old

\textbf{Not included:}
- \textit{Calls where CPR was already in progress}
- \textit{Spatial limitations on caller}
- \textit{Physical limitations on caller}
Setting: Arizona

Population
State Pop: 6.6 million

Maricopa Co: ~ 4 million

EMS System
Emergency Dispatch Centers: 9
EMS Agencies: 190
Cardiac Hospitals: 40
Bundled T-CPR Intervention
Training
Protocols
QI Process
T-CPR Training

- 3.5-hour in-person training
- 1.0-hour web-based training
- Offered additional live in-person trainings and a series of T-CPR Webinars
T-CPR Protocol

- Implemented AHA guideline-based protocols:
  - Focus on 2-Question Model
    - Is the patient conscious?
    - Is the patient breathing normally?
  - Emphasis on early ID of gasping, being assertive, and starting CPR as early as possible

Lerner, Circulation 2012
Used timestamp methodology in auditing 5,987 confirmed and suspected 9-1-1 audio recordings for key performance metrics:

1. % cases arrest recognized
2. % cases CPR instructions started
3. % cases compressions started
4. Time to recognition
5. Time to start of CPR instructions
6. Time to first bystander compression

Dameff Resuscitation 2014
QI – Feedback

Data Collection

Training/Retraining

Reporting/Benchmarking

Feedback (individual & organizational)

AHA Guidelines
Circulation 2010
## Demographics by P1 and P2

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Total (N=3619)</th>
<th>P1 (N=1289)</th>
<th>P2 (N=2330)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years), median</td>
<td>65.0%</td>
<td>64.0%</td>
<td>65.0%</td>
<td>0.17</td>
</tr>
<tr>
<td>9-17</td>
<td>0.7%</td>
<td>0.4%</td>
<td>0.8%</td>
<td>0.14</td>
</tr>
<tr>
<td>18+</td>
<td>99.3%</td>
<td>99.6%</td>
<td>99.2%</td>
<td>0.14</td>
</tr>
<tr>
<td>Male sex</td>
<td>62.7%</td>
<td>62.8%</td>
<td>62.7%</td>
<td>0.97</td>
</tr>
<tr>
<td>Witnessed Arrest</td>
<td>33.6%</td>
<td>31.3%</td>
<td>35.1%</td>
<td>0.018</td>
</tr>
<tr>
<td>Shockable Rhythms</td>
<td>18.1%</td>
<td>18.8%</td>
<td>17.7%</td>
<td>0.44</td>
</tr>
<tr>
<td>Public Location of OHCA</td>
<td>17.9%</td>
<td>17.1%</td>
<td>18.4%</td>
<td>0.34</td>
</tr>
<tr>
<td>Dispatch to Arrival (min)</td>
<td>5 (4-6)</td>
<td>5 (4-6)</td>
<td>5 (4-6)</td>
<td>0.58</td>
</tr>
<tr>
<td>Provision of TH</td>
<td>11.9%</td>
<td>9.4%</td>
<td>13.4%</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Cardiac Etiology</td>
<td>96.2%</td>
<td>95.9%</td>
<td>96.4%</td>
<td>0.47</td>
</tr>
</tbody>
</table>
Enrollment for Primary Outcomes

Total Calls Evaluated: 5,987
- CPR not needed: 4,249
- EMS Confirmed Arrests: 4,249
- Patient < 8 years: 75
- Outside Maricopa County: 175

Exclusions:
- 1,738 CPR not needed
- 75 Patient < 8 years
- 175 Outside Maricopa County

Incomplete data:
- 109 (7.7%)
- 271 (10.4%)

Study Group:
- P1: 1,398
  - 1,289 Study Group
- P2: 2,601
  - 2,330 Study Group
T-CPR Process Rates P1 vs. P2

- **Cardiac arrest recognized**
  - P1 (Pre): 72%
  - P2 (Post): 70%
  - *p<0.001

- **CPR instructions started**
  - P1 (Pre): 46%
  - P2 (Post): 54%
  - *p<0.001

- **B-CPR started**
  - P1 (Pre): 47%
  - P2 (Post): 55%
  - *p<0.001
T-CPR Process Times P1 vs. P2

* p<0.05 Dispatcher recognized cardiac arrest

P1 (Pre) P2 (Post)

Dispatcher gave CPR instructions

Chest compressions started

<table>
<thead>
<tr>
<th>Events</th>
<th>Median Time (seconds)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dispatcher recognized cardiac arrest</td>
<td>76 71</td>
</tr>
<tr>
<td>Dispatcher gave CPR instructions</td>
<td>148 130</td>
</tr>
<tr>
<td>Chest compressions started</td>
<td>183 156</td>
</tr>
</tbody>
</table>

* p<0.05
** p<0.001
Survival and CPC P1 vs. P2

Survival to Hospital Discharge (CPC = 1 or 2)

p = 0.005

8.3 vs. 11.0

p = 0.01

5.5 vs. 7.8
Survival P1 vs. P2

<table>
<thead>
<tr>
<th></th>
<th>OR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crude – All Cases</td>
<td>1.30 (1.03, 1.64)</td>
</tr>
<tr>
<td>Crude – Cardiac Only</td>
<td>1.28 (1.01, 1.62)</td>
</tr>
<tr>
<td>Adjusted – All Cases</td>
<td>2.25 (1.45, 3.48)</td>
</tr>
<tr>
<td>Adjusted – Cardiac Only</td>
<td>2.26 (1.44, 3.54)</td>
</tr>
</tbody>
</table>
CPC Score P1 vs. P2

Favors P1

Favors P2

Crude – All Cases
1.51 (1.03, 1.64)

Crude – Cardiac Only
1.40 (1.01, 1.62)

Adjusted – All Cases
2.17 (1.45, 3.48)

Adjusted – Cardiac Only
1.99 (1.44, 3.54)

OR (95% CI)
B-CPR Rates by Year in Maricopa County

CPR Public Awareness Campaign

T-CPR Program

Year | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013
---|---|---|---|---|---|---|---|---|---
% B-CPR | 24.2 | 27.4 | 25.8 | 30.3 | 32.0 | 37.5 | 44.7 | 50.6 | 52.4
Statewide Odds Ratios for Survival by CPR Type

REFERENCE

** **
*  p <0.05

* p <0.05
**p <0.005
Discussion

- This “real-world” intervention was associated with:
  - Increase in T-CPR rates
  - Reduced time to first compression
  - Increase in survival with good neurologic outcome

- These results suggest that T-CPR is a targeted intervention that is:
  - Effective
  - Minimal capital expense
  - May be the best way to improve OHCA survival
Limitations

- This was a before/after implementation study, not a randomized trial
  - However, we controlled for known risk factors, clustering, and use of propensity score to reduce bias

- We cannot prove causality
  - They were independently associated
Conclusion

- The implementation of a comprehensive T-CPR bundle was independently associated with substantial improvements in T-CPR and significant increases in survival after OHCA in a large jurisdiction including multiple EMS systems.
Acknowledgements
Witnessed/Shockable Rhythm:

- **Survival**
  - 41/128 (32%) Pre vs. 85/233 (36.5%) Post – p=0.42
  - Crude OR 1.23 (0.78-1.96)
  - Adjusted OR 1.60 (0.70-3.65)

- **CPC (1 or 2)**
  - 32/124 (25.8%) Pre vs. 71/231 (30.7%) Post – p=0.39
  - Crude OR 1.30 (0.79-2.14)
  - Adjusted OR 1.59 (0.66-3.85)