Dispatching Lay Rescuers Through a Smartphone Application is Associated with Increased Bystander Defibrillation in Out-of-Hospital Cardiac Arrest

Linn Andelius, MD, PhD student

*Emergency Medical Services Copenhagen, University of Copenhagen, Denmark.*
Disclosure Information Elements

Linn Andelius

Dispatching Lay Rescuers Through a Smartphone Application is Associated with Increased Bystander Defibrillation in Out-of-Hospital Cardiac Arrest

FINANCIAL DISCLOSURE
Unrestricted research grant from the Danish foundation TrygFonden

UNLABELED/UNAPPROVED USES DISCLOSURE:
None
### Background

Early defibrillation increases survival after out-of-hospital cardiac arrest.
AED deployment is not enough!

USA, population: 326 million
AEDs sold: > 2 400 000 AEDs
Bystander defibrillation: only 2.1% *

Japan, population: 127 million
AEDs sold: ~ 500 000 AEDs sold
Bystander defibrillation: only ~1%**

Denmark, population: 5.8 million
AEDs sold: ~ 25 000 AEDs
Bystander defibrillation: only 4.4% ***

* G.Nichol. Circulation. 2014;130:1844-1846
*** Danish Cardiac Arrest Registry, 2016
# Background

The Danish AED-network holds **18 700 AEDs in Denmark**

- In Copenhagen, Denmark:
  - 1.8 million inhabitants
  - **306 AEDs/100,000 inhabitants**
  - **186 heart runners/100,000 inhabitants**

- 8 000 AEDs and 32 000 heart runners in Chicago

---

AHA, ReSS 10 November 2018

Linn Andelius
Background

Aims

Methods

Results

Conclusions

Perspectives

1 800 meters

9-1-1

Suspected cardiac arrest
Alert received 1:56

A suspected cardiac arrest has occurred in your vicinity. Are you available?

Yes

No

Retrieve an AED and bring it to the cardiac arrest location

Dispatch Center

AHA, ReSS 10 November 2018
Linn Andelius
We examined

1) The proportion of dispatched citizen responders (heart runners) who arrive at scene prior to Emergency Medical Services

2) The association between dispatch of citizen responders (heart runners) and bystander defibrillation
### Methods

**Inclusion criteria**
Out-of-hospital cardiac arrests in the Capital Region of Denmark between September 1, 2017 and September 1, 2018 where the Heart Runner system was activated.

**Exclusion criteria**
- Do Not Resuscitate and patients where resuscitation is not indicated
- Obvious signs of death
- Traumatic cardiac arrests
- EMS witnessed arrests

**Survey from heart runners**
Did you arrive before EMS? Yes
837 suspected OHCAs where the Heart Runner system was activated between September 2017-2018

508 cardiac arrests

433 Cardiac arrests included in study

175 (40%) cardiac arrests where at least one heart runner arrived prior to EMS

258 (60%) cardiac arrests where no heart runner arrived before EMS

311 not cardiac arrests

18 no heart runner nearby

24 Obvious signs of death
7 Trauma/suicide/drowning
6 Do not resuscitate
5 EMS witnessed OHCA
5 No indication for resuscitation

28 Missing survey response
433 cardiac arrests

6,742 alerted heart runners (16 heart runners/alarm)

3,433 responded to the alarm

44% (1,511/3,433) accepted the alarm

91% of all heart runners who accepted the alarm answered the survey

351 (34%) arrived prior to EMS
<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Total</th>
<th>Heart runners prior to EMS</th>
<th>EMS first</th>
<th>P-Value</th>
<th>Missing %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cardiac arrests, n</td>
<td>433</td>
<td>175</td>
<td>258</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Median age, years</td>
<td>72</td>
<td>73</td>
<td>71</td>
<td>0.073</td>
<td>2.5</td>
</tr>
<tr>
<td>Male, %</td>
<td>68</td>
<td>69</td>
<td>67</td>
<td>0.62</td>
<td>2.5</td>
</tr>
<tr>
<td>Residential location, %</td>
<td>82</td>
<td>81</td>
<td>82</td>
<td>0.79</td>
<td></td>
</tr>
<tr>
<td>Witnessed, %</td>
<td>55</td>
<td>52</td>
<td>57</td>
<td>0.29</td>
<td>1</td>
</tr>
<tr>
<td>Shockable rhythm, %</td>
<td>30</td>
<td>35</td>
<td>26</td>
<td>0.04</td>
<td>7</td>
</tr>
<tr>
<td>Median EMS response time, min:sec</td>
<td>05:41</td>
<td>07:06</td>
<td>05:03</td>
<td>&lt;0.0001</td>
<td></td>
</tr>
<tr>
<td>Median heart runner response time (calculated), min:sec</td>
<td>08:21</td>
<td>08:25</td>
<td>08:20</td>
<td>0.9722</td>
<td></td>
</tr>
<tr>
<td>Median time difference between EMS dispatch and heart runner dispatch, min:sec</td>
<td>00:43</td>
<td>00:25</td>
<td>00:51</td>
<td>&lt;0.0001</td>
<td></td>
</tr>
<tr>
<td>Median number of heart runners alerted per alarm, n</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>&lt;0.0001</td>
<td></td>
</tr>
<tr>
<td>Median number of heart runners accepted per alarm, n</td>
<td>4</td>
<td>5</td>
<td>3</td>
<td>&lt;0.0001</td>
<td></td>
</tr>
</tbody>
</table>
Results

- **Bystander CPR** (P=0.014)
  - 86% (n=151/175)
  - 77% (n=198/258)

- **Bystander defibrillation** (P<0.0001)
  - 23% (n=40/175)
  - 7% (n=19/257)

**Perspectives**

AHA, ReSS 10 November 2018  
Linn Andelius
Conclusions

- >20,000 volunteer citizens registered as heart runners
- 1,511 (44%) accepted the alarm
- 34% of all heart runners arriving at scene arrived prior to EMS

In cardiac arrests where at least one heart runner arrived prior to EMS:
- More victims had a shockable rhythm, 35% vs. 26%
- Bystander defibrillation was threefold increased to 23% of all cases
What is next….

Controlled randomized trial to investigate

- effect on 30-days survival as primary outcome
- distances where activation of heart runners is effective
- safety of the system and risk for physical injuries and psychological distress
Thanks to

The co-authors:

Carolina Malta Hansen
Freddy Lippert
Lena Karlsson
Christian Torp-Pedersen
Gunnar Gislason
and Fredrik Folke

For research funding:

The Danish foundation

TrygFonden
Secondary endpoint

- **ROSC at any time**
  - Heart runner arrived prior to EMS: 38% (n=66/175)
  - EMS arrived first: 36% (n=93/257)

- **ROSC at hospital admission**
  - Heart runner arrived prior to EMS: 33% (n=57/175)
  - EMS arrived first: 30% (n=76/257)

**P-values**
- **ROSC at any time**: P=0.75
- **ROSC at hospital admission**: P=0.51
What happens after the alarm...

All dispatched heart runners receive a survey

Were there any technical problems?

Did you retrieve an AED and did you shock the victim?

Where you in risk of physical injuries?

0 reported cases of injuries with need of care

Did you get psychologically distress by the situation?

"Severely" 1,4% (n=40/2923)

Do you want to be contacted?

Debriefing by healthcare person
<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Total</th>
<th>Heart runners prior to EMS</th>
<th>EMS first</th>
<th>P-Value</th>
<th>Missing %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cardiac arrests, n</td>
<td>433</td>
<td>175</td>
<td>258</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ROSC, n (%)</td>
<td>159 (37)</td>
<td>66 (38)</td>
<td>93 (36)</td>
<td>0.75</td>
<td>1</td>
</tr>
<tr>
<td>Alive at hospital admission, n (%)</td>
<td>133 (31)</td>
<td>57 (33)</td>
<td>76 (30)</td>
<td>0.51</td>
<td>1</td>
</tr>
</tbody>
</table>
Currently 30 247 heart runners
<table>
<thead>
<tr>
<th>Why did you not accept the alarm?</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>I was unavailable to accept</td>
<td>74%</td>
</tr>
<tr>
<td>I did not feel comfortable accepting the alarm</td>
<td>7%</td>
</tr>
<tr>
<td>I expected EMS to arrive before me</td>
<td>9%</td>
</tr>
<tr>
<td>Technical problems with the app</td>
<td>9%</td>
</tr>
</tbody>
</table>
Figure 3. Bystander Defibrillation According to the Location of the Out-of-Hospital Cardiac Arrest (OHCA) and Registered Automated External Defibrillator (AED) Units
1,520 patients with out-of-hospital cardiac arrest in the Danish Cardiac Arrest Registry between September 2017-2018 resulted in 143 EMS witnessed OHCA, 30 No indication for resuscitation, 64 Trauma/suicide/drowning, 72 Obvious signs of death, 53 DNR, 68 Children under the age of 8 years, 13 No Heart runners nearby, 616 Heart Runner app not activated, and 28 Missing survey response.

433 Cardiac arrests included in study:
- 175 (40%) cardiac arrests where at least one heart runner arrived prior to EMS
- 258 (60%) cardiac arrests where no heart runner arrived before EMS