Sudden death rescued with the help of an App
ACCA Masterclass 2017

Finn Lund Henriksen, MD, PhD
Declaration of interest

- Teaching for MSD, AstraZeneca, Sanofi.
- Developed FirstAED GPS technology and applied for patent.
- Granted by the Danish Heart Foundation.
- Granted by the Danish Technological Institute.
- Granted by the Danish Market Development Fund.
The chain of survival

European Resuscitation Council Guidelines for Resuscitation 2015, Gavin D. Perkins
Bystander - Early Heart Lung Resuscitation to buy time
Layresponder - early defibrillation to restart the heart
The Global Resuscitation Alliance
Utstein Meeting 2015 - EMS Copenhagen 2016

Improving Survival from Out-of-Hospital Cardiac Arrest:

A Call to Establish a Global Resuscitation Alliance

• Emergency Medical Services (EMS) leaders, researchers, and experts convened to discuss the challenge of how to increase out of hospital cardiac arrest survival
Title: AHA Scientific Statement
Use of Mobile Devices, Social Media, and Crowdsourcing as Digital Strategies to improve Emergency Cardiovascular Care

Author: John S. Rumsfeld, MD, PhD, FAHA, Chair; Steven C Brooks, MD, MHSc; Tom P. Aufderheide, MD, FAHA; Marion Leary, MPH, MSN, RN, FAHA, et al.

Publication: Circulation
Date: June 21, 2016

Findings: Digital strategies represent novel interventions to potentially improve care delivery and patient outcomes for emergency cardiovascular conditions.

<table>
<thead>
<tr>
<th>Research Agenda of Emergency Cardiovascular Conditions and Digital Strategies (selected issues)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cardiac Arrest</td>
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<tr>
<td>-----------------</td>
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<tr>
<td>Mobile</td>
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</table>
Strategies to Improve Cardiac Arrest Survival
A Time to Act

Educating and Engaging the Public
Following a cardiac arrest, each minute without treatment decreases the likelihood of survival without disability. Without treatment within 10 minutes, the survival rate is almost zero. Because minutes count, the public plays a crucial role in saving a life by being prepared and willing to deliver basic life support before the arrival of professional emergency responders.

Basic life support includes first identifying an event, calling 911, administering early cardiopulmonary resuscitation (CPR), and using a publicly available automated external defibrillator (AED) device. Evidence indicates that bystander CPR and AED use can significantly improve survival and outcomes from cardiac arrest. Yet less than 3 percent of the U.S. public receives CPR training annually, rendering many bystanders unprepared to respond.
Likelihood of survival
The Utstein Formula
Interaction between Medical Dispatcher & Bystander
Timely use of an AED

• The medical dispatcher plays an important role in:
  • the diagnosis of cardiac arrest,
  • the provision of dispatcher-assisted CPR (also known as telephone CPR),
  • the location and dispatch of an AED.

European Resuscitation Council Guidelines for Resuscitation 2015, Gavin D. Perkins
The chain of survival – 4 prehospital links
Early access, early CPR, early defibrillation, early advanced care

A call to establish a Global Resuscitation Alliance, Utstein meeting, Stavanger 2015
Best practice and actions

Programs

- Cardiac arrest registry
- Telephone CPR
- High performance CPR
- Rapid dispatch
- Measurement of professional resuscitation
- AED program for first responders
- Smart technologies for CPR and AED
- Mandatory training for CPR and AED
- Accountability
- Culture of excellence

Actions

- Form a team
- Select programs
- Plan implementation strategy
- Set specific goals
- Achieve buy-in
- Establish standards
- Pilot the program
- Consult experts
- Communicate progress
- Support, advocate, celebrate

Improved Survival

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Action: Rescuer involvement

- **Bystander**
  - Public information
- **Lay responder**
  - HLR education
- **First responder**
  - Semi professional
    - Police
    - Firemen
The rescuer needs to arrive not just earlier than the traditional ambulance, but within 5-6 minutes of the initial call.

Small reductions in response intervals achieved by first-responder programmes may be cost-effective.
Action: Public versus residential place

AED’s are mostly used in public settings.
60-80% of cardiac arrests occur at home.
Action: Network of Automatic External Defibrillators (AEDs)

What is important about AEDs?
Action: Network of Automatic External Defibrillators (AEDs)

- **Availability**
  - 24 hours / 7 days a week
- **Location**
  - distance between AED’s
- **AED network**
- **Pads fits defibrillator in**
  - ambulance
  - helicopter
- **AED downloads**
  - ECG & HLR data
How do we activate the inhabitants?

- What is important?
Action: Initiation - Dispatching – Prehospital Medical Care
Title: Local lay rescuer with AEDs, alerted by text messages, contribute to early defibrillation in a Dutch out of hospital cardiac arrest dispatch system

Author: Zijlstra Jolanda, Stieglis Remy, Koster Rudolph et al.

Publication: Resuscitation

Date: July 28, 2014

Findings: A text message alert system that includes local rescuers and AEDs contributes to earlier defibrillation in out-of-hospital Cardiac Arrest, particularly in residential areas.

AmstRdam Resuscitation Studies (ARREST) (n=893)

<table>
<thead>
<tr>
<th>TM-lay rescuers (BLS/AED course)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zip-code SMS</td>
</tr>
<tr>
<td>AED network</td>
</tr>
</tbody>
</table>

*TM-lay rescuers AED defibrillated 2:39 (min:sec) earlier than the ambulance*
A text message alert system for trained volunteers improves out-of-hospital cardiac arrest survival

Author: Ruud W.M. Pijls, Patty J. Nelemans, Braim M. Rahel, Anton P.M. Gorgels

Publication: Resuscitation

Date: June 8, 2016

Findings: The text message alert system is effective in increasing survival to hospital discharge in OHCA victims and the degree of disability or dependence after survival is low.

Dutch province of Limburg (Maastricht) (n=833)

- TM-lay rescuers (BLS/AED course)
- First responders (police)
- Zip-code SMS
- AED network

Survival at discharge 27.1% (≥ 1 TM) versus 16% (0 TM) p=0.001
Stockholm (n=667)

Randomized trial

Lay rescuers (BLS/AED course)

First responders (police)

Mobile-Phone Positioning system SMS

**Bystander initiated CPR was 62% in the intervention group versus 48% in the control group, p<0.001**
Title: Better management of out-of-hospital cardiac arrest increases survival rate and improves neurological outcome in the Swiss Canton Ticino

Author: Mauri Romano, Burkart Roman, Benvenuti Claudio et al.

Publication: Europace

Date: September 7, 2015

Findings:
- Dispatched cardiopulmonary resuscitation (CPR) steadily and significantly increased from 2005-2014.
- Out-of-hospital cardiac arrest occurred prevalently home (67%).
- Swiss Canton Ticino – SMS solution (n=454)
  - Lay rescuers (BLS/AED course)
  - First responders (police, firemen)
  - SMS (zip-code)
  - AED network

There was a progressive increase in the proportion of patients achieving survival at discharge from 15% in 2005 to 55% in 2014.
Title: Lay persons alerted by mobile application system initiate earlier cardio-pulmonary resuscitation: a comparison with SMS-based system notification

Author: Caputo Maria Luce, Muschietti Sandro, Burkart Roman, Benvenuti Claudio, Conte Giulio, Regoli François, Mauri Romano, Klersy Catherine, Moccetti Tiziano, Auricchio Angel

Publication: Resuscitation

Date: March 4, 2017

Findings: The mobile app system is highly efficient in the recruitment of first responders, significantly reducing the time to the initiation of CPR thus increasing survival rates.

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**Swiss Canton Ticino - SMS versus App solution (n=332)**

<table>
<thead>
<tr>
<th>Survival at discharge n (%)</th>
<th>SMS</th>
<th>APP</th>
<th>OR* (95% CI)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall</td>
<td>37 (17)</td>
<td>43 (28)</td>
<td>0.53 (0.34-0.82)</td>
<td>0.004</td>
</tr>
<tr>
<td>Shockable rhythm</td>
<td>31 (37)</td>
<td>29 (49)</td>
<td>0.61 (0.32-1.14)</td>
<td>0.126</td>
</tr>
<tr>
<td>Non-shockable rhythm</td>
<td>6 (6)</td>
<td>14 (17)</td>
<td>0.32 (0.16-0.66)</td>
<td>0.002</td>
</tr>
</tbody>
</table>

*OR of dying for APP with respect to SMS

FR: first responder; ROSC: return of spontaneous circulation
Recommendation 2
There should be developed telecommunications / Internet based applications as the presence of AED’s can be easily found with mobile phones and other IT equipment.

Recommendation 4
AEDs should be located in sparsely populated areas with relatively long ambulance response times and should be placed in well-known places such as city squares, by mailboxes and the like, and should be accompanied by a first-responder program.
First AED emergency dispatch, global positioning of first responders with distinct roles – a solution to reduce response times and ensuring early defibrillation on the Langeland island
The Langeland Island
Out of Hospital Cardiac Arrest research area
Background – Cardiac Arrest – the Langeland Island

• ~ 13,000 inhabitants
  • ~ 60,000 tourists in the summer
• Long distances to the two nearest hospitals (55 km, 90 km)
• Long ambulance response times (30 % ≥ 15 minutes)
• 95 AEDs available around the clock
• Lay rescuers response times (≥ 10 minutes)
• Bystander CPR provided by 215 trained first responders
Purpose – Cardiac Arrest

- GPS tracking of trained volunteer first responders
- At least one of the first responders and the AED need to arrive not just earlier than the traditional ambulance, but within 5-6 minutes of the initial call
- The system establish an emergency team of 3 first responders with distinct roles

Typical current logistics flow

1-1-2 call  Call taking  Dispatch  First responder/ AED transport  First responder CPR  Ambulance/ Paramedic arrival

< 300-360 Seconds

Henriksen FL et al.. Int. J. Networking and Virtual Organisations 2016: Vol. 16; page 86-101
FirstAED activate trained volunteer first responders
How does it work?

**Dispatch Centre**
Intelligent and easy to use tool for alarming the geographically closest first responders for medical emergencies, and other types of call-outs. Includes reporting and statistics on cases.

**First responders**
Intelligent and easy to use smartphone application with AED locations, GPS tracking and team organization (+more)

**AEDs**
Management of the AEDs and cabinets, or other hardware, for optimal visibility during the dark hours, 24-7 access and theft prevention.

**Citizen alarm (option)**
1-1-2

Henriksen FL et al.. Int. J. Networking and Virtual Organisations 2016: Vol. 16; page 86-101

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First responders involved in all 1-1-2 emergency call

- Cardiac arrest
- Acute illness
- Accident
- Fire/ traffic accident
- Other
Action: Emergency call - Cardiac Arrest - 2 weeks ago

Dispatch Center iPad – GPS tracking

- All first responders (n= 215 (purple pushpins))
- AED’s (n = 95 (green pushpins))
- Emergency Call Activate dispatching – GPS Tracking (touch red marker)
Emergency Medical Dispatch Centre - Cardiac Arrest

Nearest first responders are called based on actual GPS position.

3 most optimum responders are automatically chosen and assigned roles.

You can see the location and roles of all the first responders. Arrival times are GPS decided.

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First responder telephone: Emergency call - Cardiac Arrest

Around 1.5 km north

Do you want to accept the alarm?

No Yes

Cardiac arrest: Havnegade 8, 5900
1. Collect the AED (code 1234)
2. Go for the emergency place
# Key results of the 24 months: Dispatch categories

<table>
<thead>
<tr>
<th>Alarm type</th>
<th>Number</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acute illness</td>
<td>591</td>
<td>~ 82.3 %</td>
</tr>
<tr>
<td>Accident</td>
<td>55</td>
<td>~ 7.7 %</td>
</tr>
<tr>
<td>Cardiac Arrest</td>
<td>32</td>
<td>~ 4.4 %</td>
</tr>
<tr>
<td>Fire/ traffic accident</td>
<td>25</td>
<td>~ 3.5 %</td>
</tr>
<tr>
<td>Others</td>
<td>15</td>
<td>~ 2.1 %</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>718</strong></td>
<td></td>
</tr>
</tbody>
</table>
Results: Response times

<table>
<thead>
<tr>
<th>Response time – Langeland</th>
<th>Time seconds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Median</td>
<td>n = 718</td>
</tr>
<tr>
<td>First Person On Site</td>
<td>249 sec. [1-1297 sec.]</td>
</tr>
<tr>
<td>AED On Site</td>
<td>347 sec. [1-1996 sec.]</td>
</tr>
<tr>
<td>Ambulance/paramedic On Site</td>
<td>802 sec. [93-2692 sec.]</td>
</tr>
</tbody>
</table>
Results: Arrival – Number of first responders

<table>
<thead>
<tr>
<th>Arrival On Site</th>
<th>Team</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>3 first responders</td>
<td>X</td>
<td>89.1 %</td>
</tr>
<tr>
<td>2 first responders</td>
<td>X</td>
<td>7.1 %</td>
</tr>
<tr>
<td>1 first responders</td>
<td></td>
<td>3.0 %</td>
</tr>
<tr>
<td>0 first responders</td>
<td></td>
<td>0.8 %</td>
</tr>
</tbody>
</table>
## Results: AED On Site

<table>
<thead>
<tr>
<th>AED On Site</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>710</td>
<td>98.9%</td>
</tr>
<tr>
<td>No</td>
<td>8</td>
<td>1.1%</td>
</tr>
</tbody>
</table>
Response times:
First responder versus paramedics/ambulances

24 months data - response times

- First responder
- Paramedic/Ambulance

P < 0.001
Key results of the first 24 months

- **8 Cardiac arrests**
  - 5 survived, 3 survived more than 30 days.
- **8 Respiratory insufficiency**
  - 7 survived more than 30 days, 1 died at the hospitalet.
- **29 Acute Myocardial Infarction**
  - All survived more than 30 days.
- **3 Hangings**
  - 1 survived more than 30 days, 2 died.
- **2 Divers with decompression sickness**
  - Complete restituted.
- **1 Subarachnoid haemorrhage**
  - Complete restituted.
Conclusion:

• The FirstAED GPS app technology entails a significant reduction in first responder median response times from more than 10 minutes before to 4 minutes 9 seconds after.

• FirstAED organizes the three first responders in an emergency team with distinct roles.

• FirstAED activate the AED cabinets (unlock, sound & flash light).
CPR – GPS - Apps

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Quality of education and local implementation

A call to establish a Global Resuscitation Alliance, Utstein meeting, Stavanger 2015
Thank you for your attention!