Sudden death rescued with the help of an App

ACCA Masterclass 2017

Finn Lund Henriksen, MD, PhD

WE ARE THE ESC

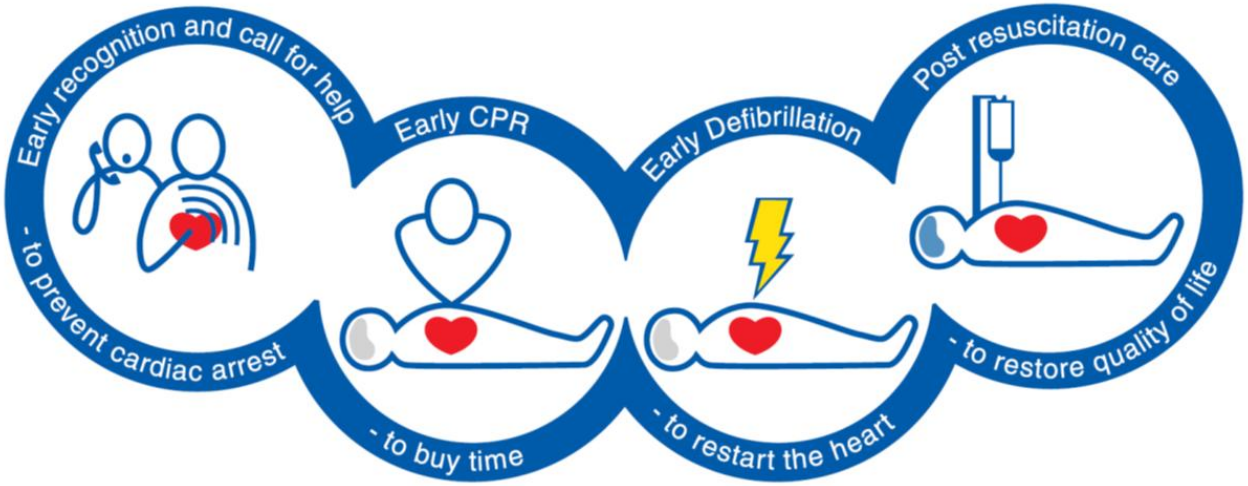
Acute Cardiovascular Care Association ACCA
A Registered Branch of the ESC

EUROPEAN SOCIETY OF CARDIOLOGY®

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.

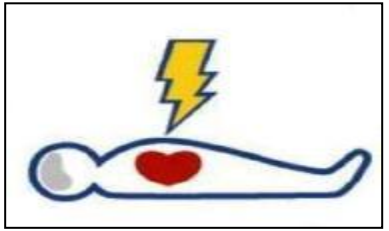
The chain of survival



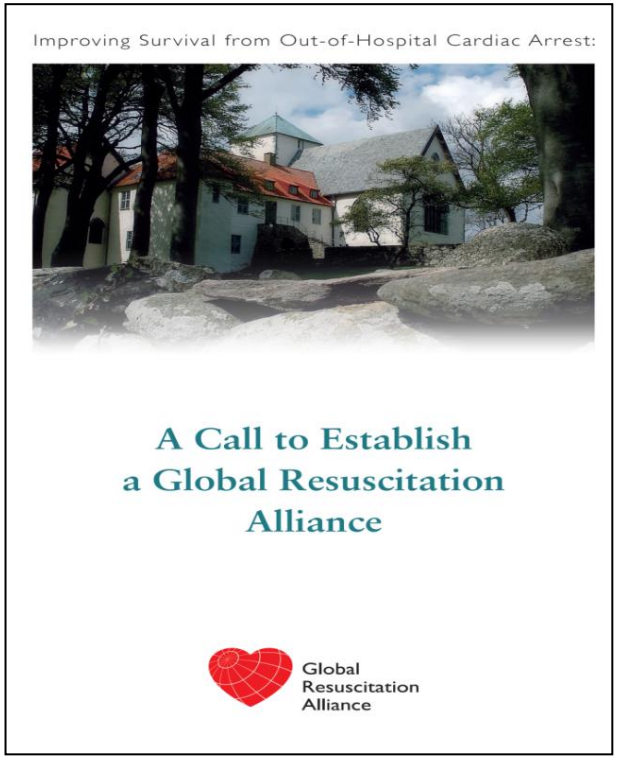
European Resuscitation Council Guidelines for Resuscitation 2015, Gavin D. Perkins

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



- Emergency Medical Services (EMS) leaders, researchers, and experts convened to discuss the challenge of how to increase out of hospital cardiac arrest survival

Circulation

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.

Reseach Agenda of Emergency Cardiovascular Conditions and Digital Strategies (selected issues)		
Cardiac Arrest	Digital Strategy	Research Questions
	Mobile	• How can we best use the mobile device to empower all bystanders to deliver high-quality CPR and defibrillation while ultimately improving survival for victims of OHCA?*

REPORT BRIEF JUNE 2015

INSTITUTE OF MEDICINE
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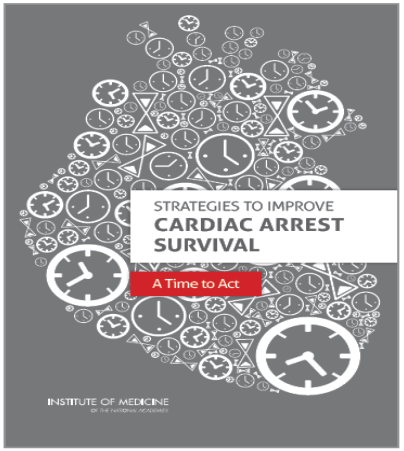
Advising the nation • Improving health

For more information visit www.iom.edu/cardiacarrest

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.

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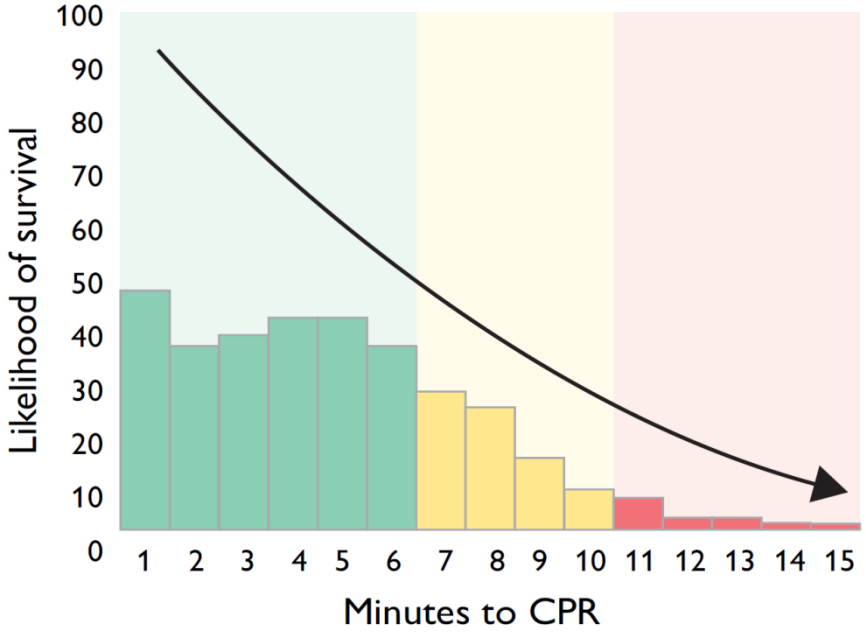
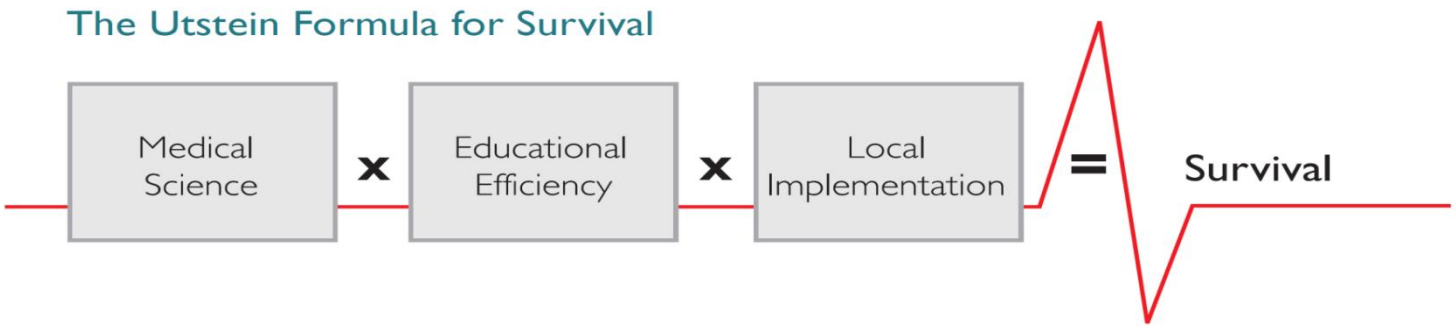
Likelihood of survival



The Utstein Formula

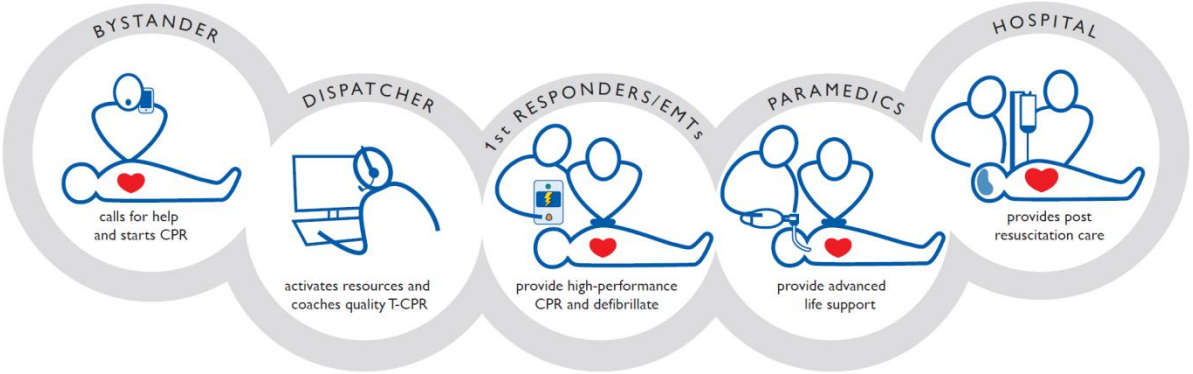


Interaction between Medical Dispatcher & Bystander Timely use of an AED

- 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.

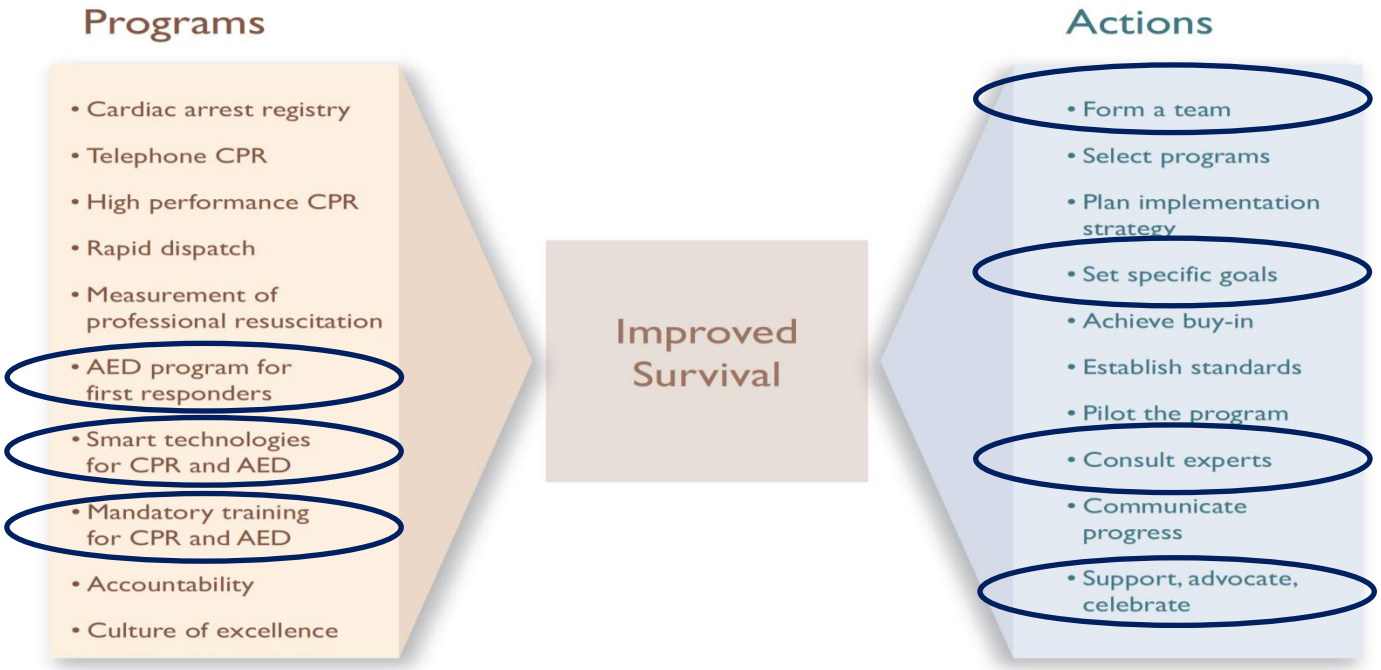
European Resuscitation Council Guidelines for Resuscitation 2015, Gavin D. Perkins

The chain of survival – 4 prehospital links
Early access, early CPR, early defibrillation, early advanced care

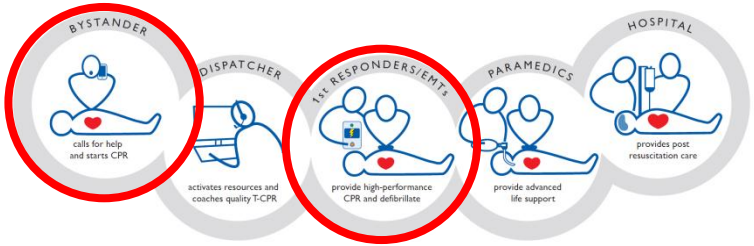


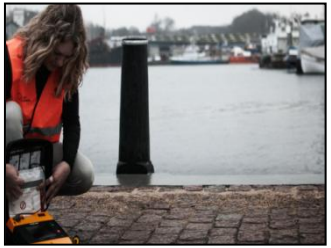
A call to establish a Global Resuscitation Alliance, Utstein meeting, Stavanger 2015

Best practice and actions



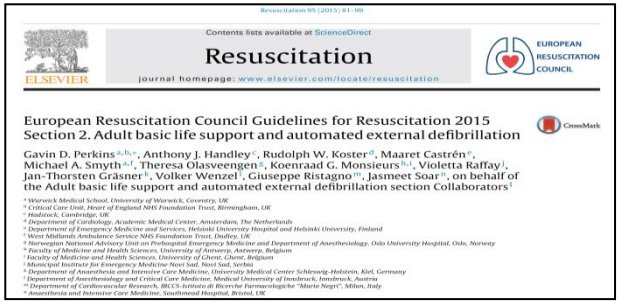
Action: Rescuer involvement





- **Bystander**
  - Public information
- **Lay responder**
  - HLR education
- **First responder**
  - Semi professional
    - Police
    - Firemen

Action: Rescuer arrival time



Resuscitation 95 (2015) 81–99

Contents lists available at ScienceDirect

Resuscitation

journal homepage: www.elsevier.com/locate/resuscitation

European Resuscitation Council Guidelines for Resuscitation 2015
Section 2. Adult basic life support and automated external defibrillation

Gavin D. Perkins[a,b,*], Anthony J. Handley[c], Rudolph W. Koster[d], Maaret Castrén[e], Michael A. Smyth[a,f], Theresa Olasveengen[g], Koenraad G. Monsieurs[h,i], Violetta Raffay[j], Jan-Thorsten Gräsner[k], Volker Wenzel[l], Giuseppe Ristagno[m], Jasmeet Soar[n], on behalf of the Adult basic life support and automated external defibrillation section Collaborators[1]

[a] Warwick Medical School, University of Warwick, Coventry, UK
[b] Critical Care Unit, Heart of England NHS Foundation Trust, Birmingham, UK
[c] Hadstock, Cambridge, UK
[d] Department of Cardiology, Academic Medical Center, Amsterdam, The Netherlands
[e] Department of Emergency Medicine and Services, Helsinki University Hospital and Helsinki University, Finland
[f] West Midlands Ambulance Service NHS Foundation Trust, Dudley, UK
[g] Norwegian National Advisory Unit on Prehospital Emergency Medicine and Department of Anesthesiology, Oslo University Hospital, Oslo, Norway
[h] Faculty of Medicine and Health Sciences, University of Antwerp, Antwerp, Belgium
[i] Faculty of Medicine and Health Sciences, University of Ghent, Ghent, Belgium
[j] Municipal Institute for Emergency Medicine Novi Sad, Novi Sad, Serbia
[k] Department of Anaesthesia and Intensive Care Medicine, University Medical Center Schleswig-Holstein, Kiel, Germany
[l] Department of Anesthesiology and Critical Care Medicine, Medical University of Innsbruck, Innsbruck, Austria
[m] Department of Cardiovascular Research, IRCCS-Istituto di Ricerche Farmacologiche "Mario Negri", Milan, Italy
[n] Anaesthesia and Intensive Care Medicine, Southmead Hospital, Bristol, UK

The logistic problem for first responder programmes is that the rescuer needs to arrive not just earlier than the traditional ambulance, but within 5–6 min of the initial call, to enable attempted defibrillation in the electrical or circulatory phase of cardiac arrest.[44] With longer delays, the survival benefits decrease:[36,47] a few minutes' gain in time will have little impact when a first responder arrives more than 10 min after the call,[14,150] or when a first responder does not improve on an already short ambulance response time.[151] However, small reductions in response intervals achieved by first-responder programmes that impact on many residential victims may be more cost-effective than the larger reductions in response interval achieved by PAD programmes that have an impact on fewer cardiac arrest victims.[152,153]

- 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

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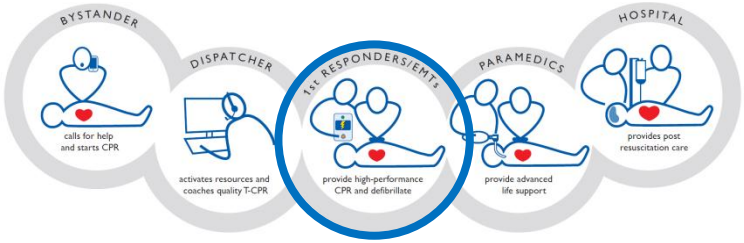
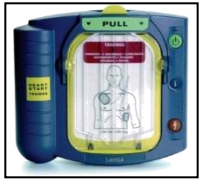
The full potential of AEDs has not yet been achieved, because they are mostly used in public settings, yet 60–80% of cardiac arrests occur at home. Public access defibrillation (PAD) and first responder AED programmes may increase the number of victims who receive bystander CPR and early defibrillation, thus improving survival from out-of-hospital SCA.[148] Recent data from nationwide studies in Japan and the USA[13,43] showed that when an AED was available, victims were defibrillated much sooner and with a better chance of survival. However, an AED delivered a shock in only 3.7% and 5% of all VF cardiac arrests, respectively. There was a clear

- AED's are mostly used in public settings.
- 60-80 % of cardiac arrests occur at home.

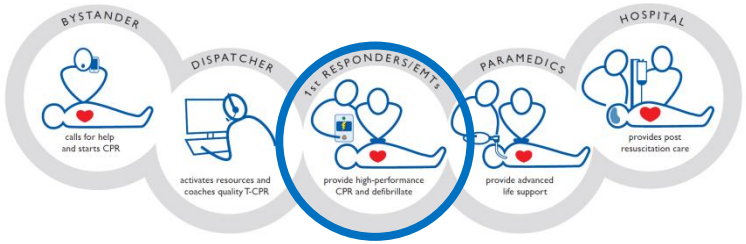
Action: Network of Automatic External Defibrillators (AEDs)

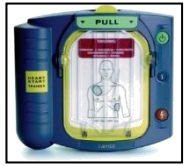




What is important about AEDs ?

Action: Network of Automatic External Defibrillators (AEDs)

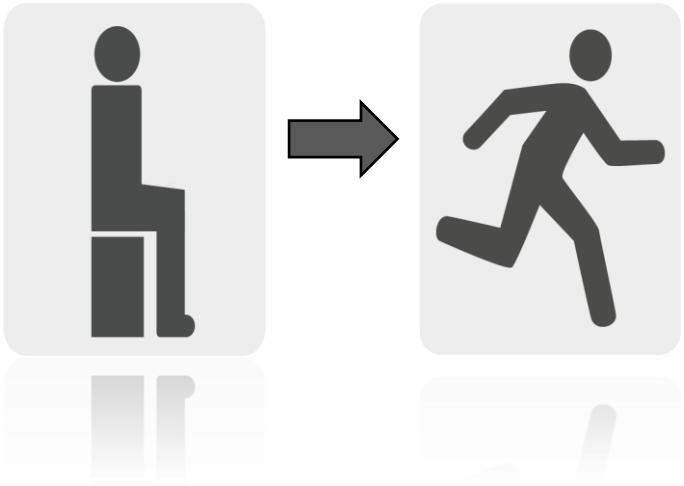




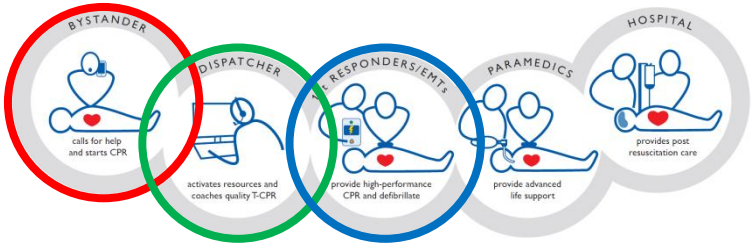
- **Availability**
  - 24 hours / 7 days a week
- **Location**
  - distance between AED's
- **AED network**
- **Pads fits defibrillator in**
  - ambulance
  - helicopter
- **AED downloads**
  - ECG & HLR data

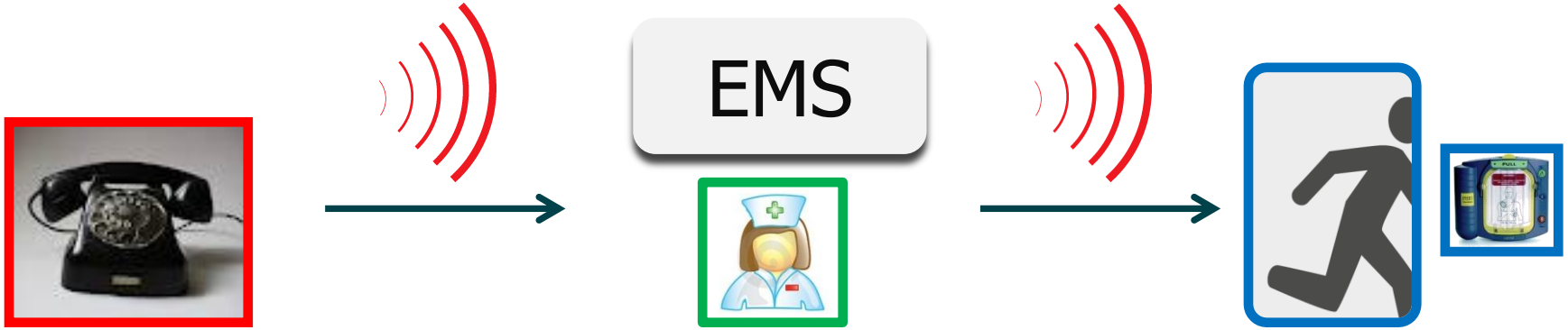
How do we activate the inhabitants ?

- **What is important ?**



Action: Initiation - Dispatching – Prehospital Medical Care





RESUSCITATION
OFFICIAL JOURNAL OF THE EUROPEAN RESUSCITATION COUNCIL

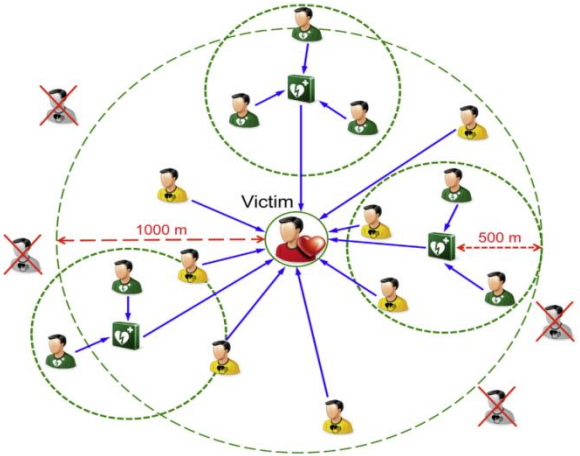
Title: Local lay rescuer with AEDs, alerted by text messages, contribute to early defibrillation in a Dutch out of hospital cardiac arrest dispatch system

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.



AmsteRdam Resuscitation Studies (ARREST) (n=893)
TM-lay rescuers (BLS/AED course)
Zip-code SMS
AED network
TM-lay rescuers AED defibrillated 2:39 (min:sec) earlier than the ambulance

RESUSCITATION
OFFICIAL JOURNAL OF THE EUROPEAN RESUSCITATION COUNCIL

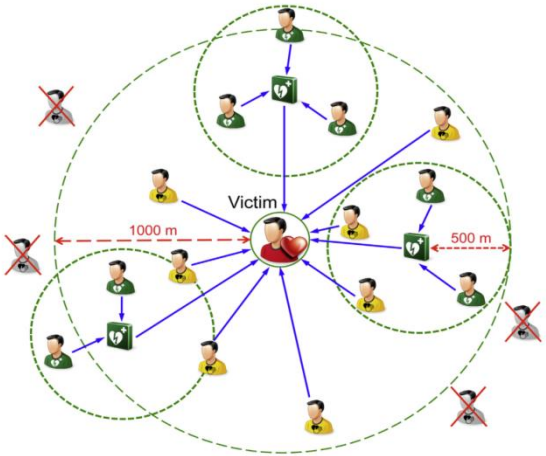
Title: A text message alert system for trained volunteers improves out-of-hospital cardiac arrest survival

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

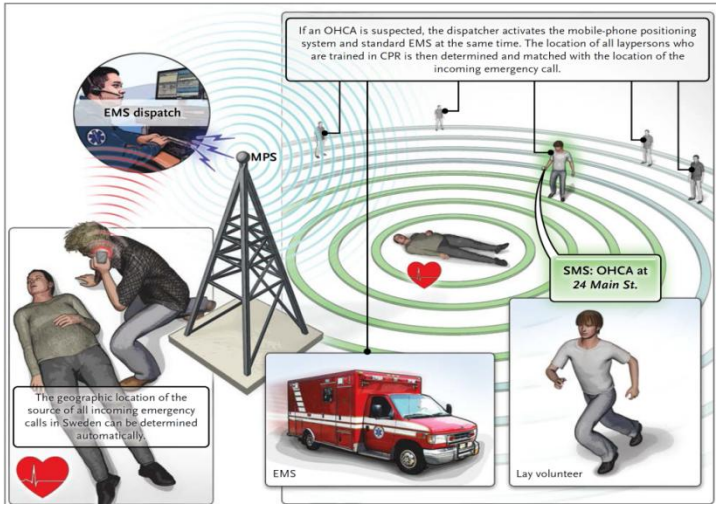
Title: Mobile-Phone Dispatch of Laypersons for CPR in Out-of-Hospital Cardiac Arrest

Author: Mattias Ringh, Mårten Rosenqvist, Jacob Hollenberg, et al

Publication: The New England Journal of Medicine

Date: June 11, 2015

Findings: A mobile-phone positioning system to dispatch lay volunteers who were trained in CPR was associated with significantly increased rates of bystander-initiated CPR among persons with out-of-hospital cardiac arrest.



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 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

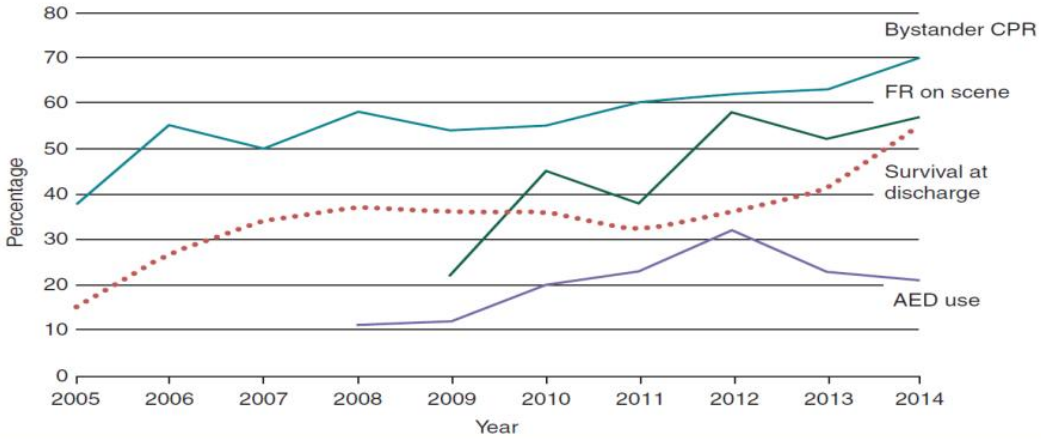


Figure 2 Pre-hospital resuscitation activities (first responders on scene, bystander-performed CPR, and AED use) and survival rate at hospital discharge (dotted line). Data for bystander-performed CPR have been collected starting in 2009; data on the use of AED have been collected starting in 2008.

RESUSCITATION
OFFICIAL JOURNAL OF THE EUROPEAN RESUSCITATION COUNCIL

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.

FONDAZIONE TICINO CUORE

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

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

*OR of dying for APP with respect to SMS

FR: first responder; ROSC: return of spontaneous circulation

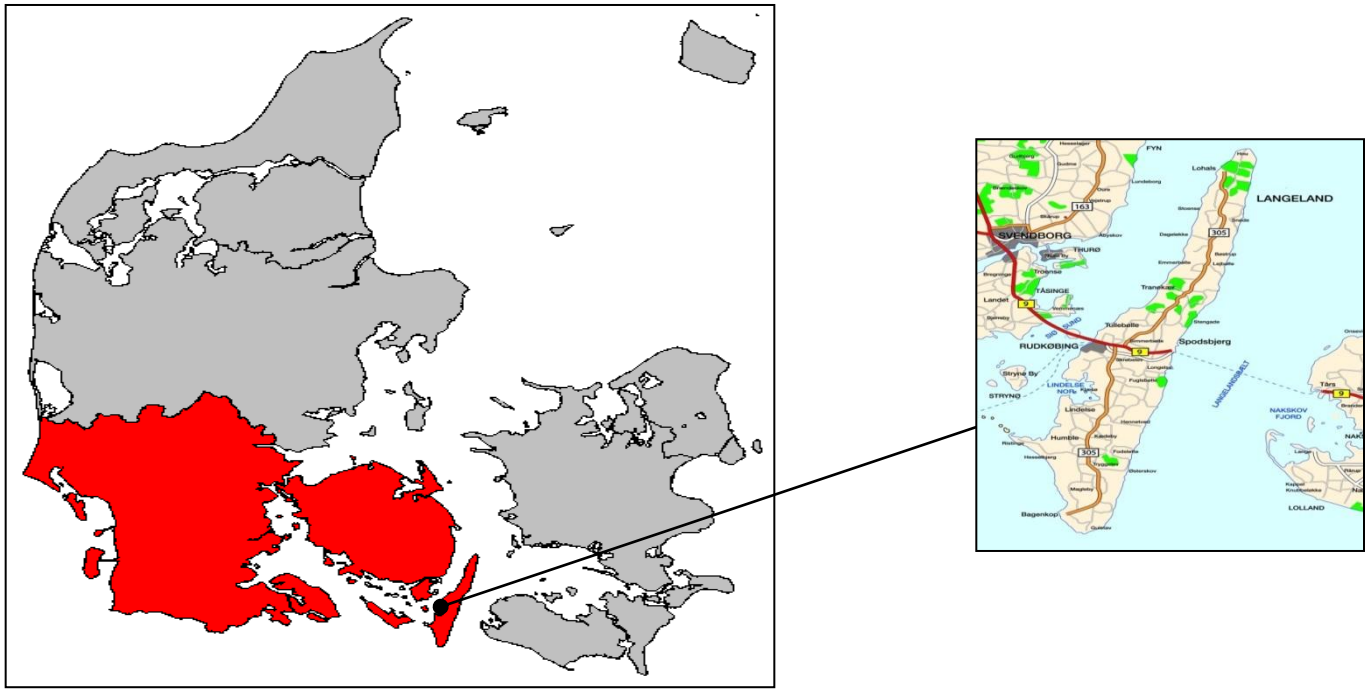
New Danish Recommandations of National Board of Health; 2011

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.

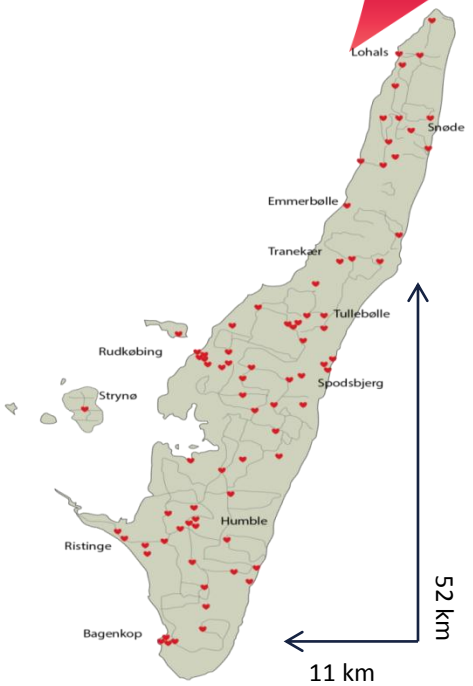
FirstAED emergency dispatch, global positioning of first responders with distinct roles – a solution to reduce response times and ensuring early defibrillation on the Langeland island

The Langeland Island
Out of Hospital Cardiac Arrest research area



Background – Cardiac Arrest – the Langeland Island

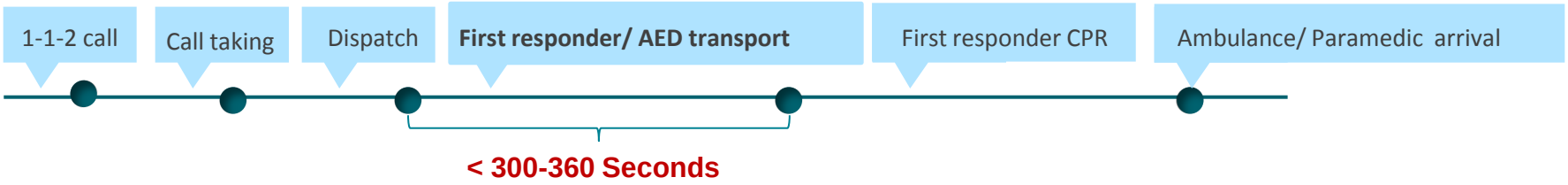
- ~ 13,000 inhabitants
  - ~ 60,000 tourists in the summer
- Long distances to the two nearest hospitals (55 km, 90 km)
- Long ambulance response times (30 % ≥ 15 minutes)
- 95 AEDs available around the clock
- Lay rescuers response times (≥ 10 minutes)
- Bystander CPR provided by 215 trained first responders



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



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

FirstAED activate trained volunteer first responders

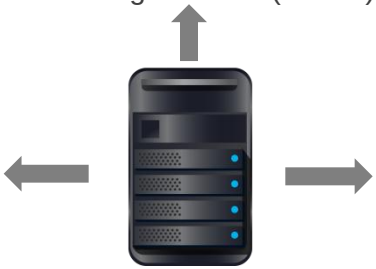
How does it work?

First responders

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

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.



Server

AEDs

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

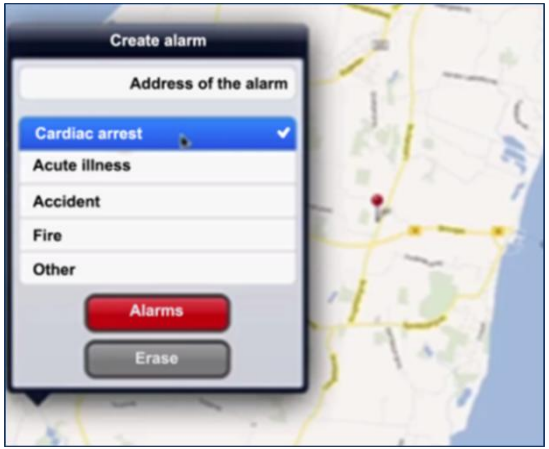
Citizen alarm (option)

1-1-2

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

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

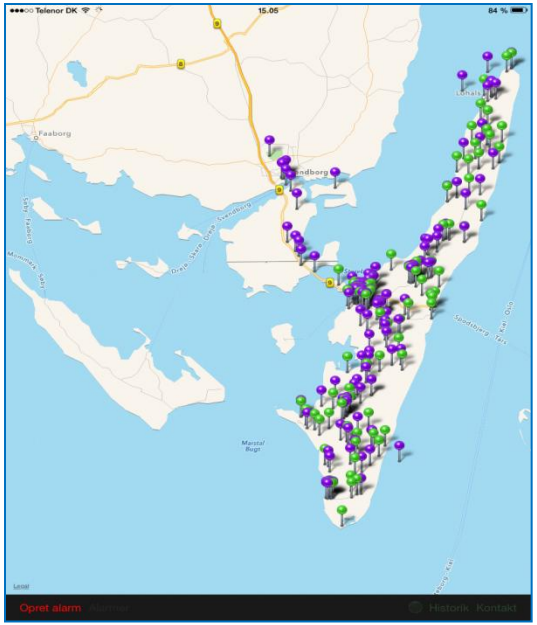
- Cardiac arrest
- Acute illness
- Accident
- Fire/ trafic accident
- Other



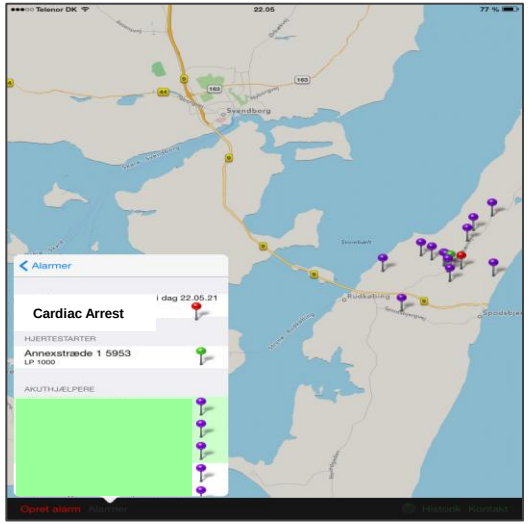
Action: Emergency call - Cardiac Arrest - 2 weeks ago

Dispatch Center iPad – GPS tracking

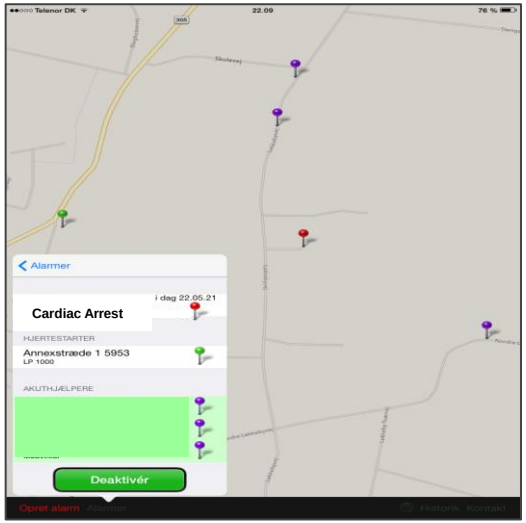
- All first responders
  (n= 215 (purple pushpins))
- AED's
  (n = 95 (green pushpins))
- Emergency Call
  Activate dispatching – GPS Tracking
  (touch red marker)



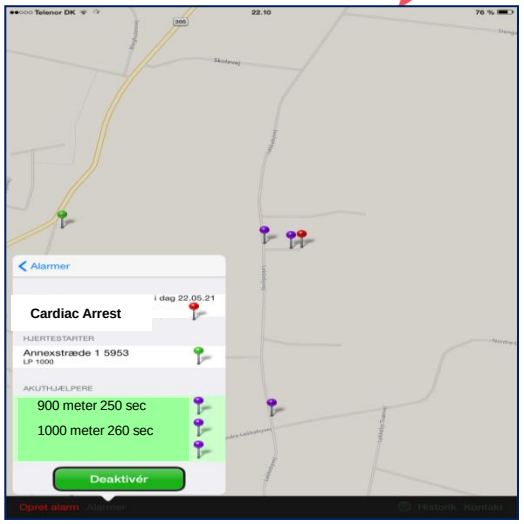
Emergency Medical Dispatch Centre - Cardiac Arrest



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

First responder telephone: Emergency call - Cardiac Arrest

Key results of the 24 months : Dispatch categories

Alarm type	Number	Percentage
Acute illness	591	~ 82.3 %
Accident	55	~ 7.7 %
Cardiac Arrest	32	~ 4.4 %
Fire/ traffic accident	25	~ 3.5 %
Others	15	~ 2.1 %
Total	**718**	

Results: Response times

Median Response time – Langeland n = 718	Time seconds
First Person On Site	249 sec. [1-1297 sec.]
AED On Site	347 sec. [1-1996 sec.]
Ambulance/paramedic On Site	802 sec. [93-2692 sec.]

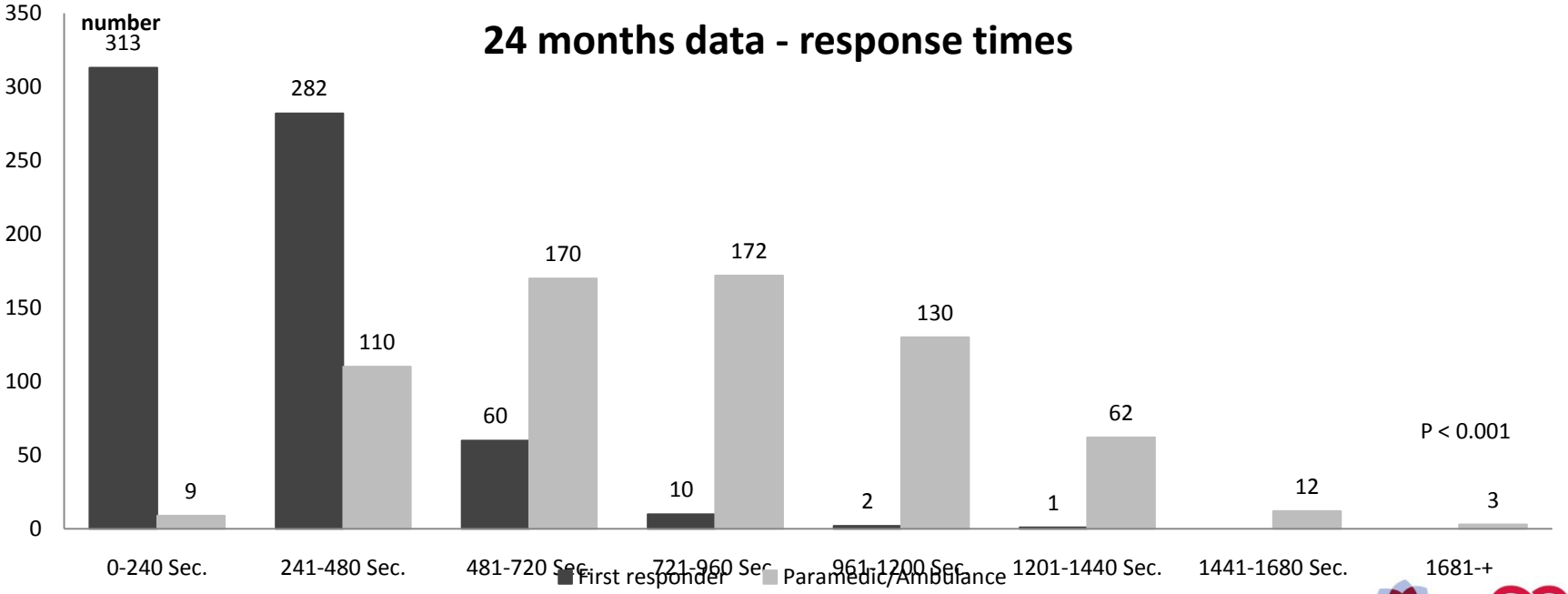
Results: Arrival – Number of first responders

Arrival On Site	Team	
3 first responders	X	89.1 %
2 first responders	X	7.1 %
1 first responders		3.0 %
0 first responders		0.8 %

Results: AED On Site

AED On Site	n	
Yes	710	98.9 %
No	8	1.1 %

Response times:
First responder versus paramedics/ambulances



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 haemorhage
  - Complete restituted.

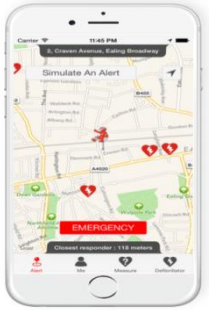
Conclusion:

- 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).

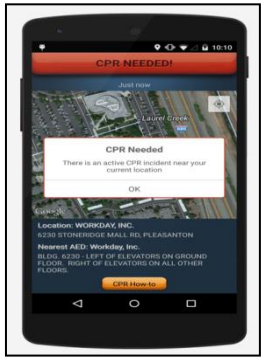
CPR – GPS - Apps

GoodSAM

Alerts trained volunteers to Cardiac Arrests
Integrates with CAD
Database of > 28,000 AEDs
Over 19,000 volunteers registered
Highly governed and flexible



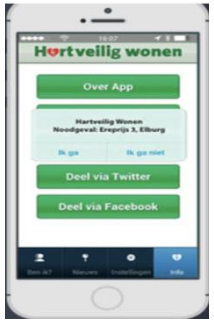
PulsePoint

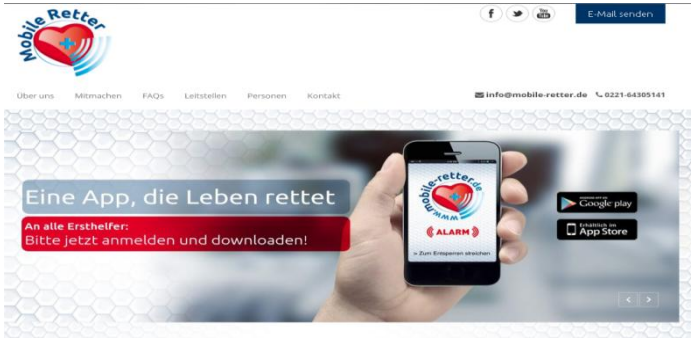


FONDAZIONE TICINO CUORE

SMSLIVRÄDDARE

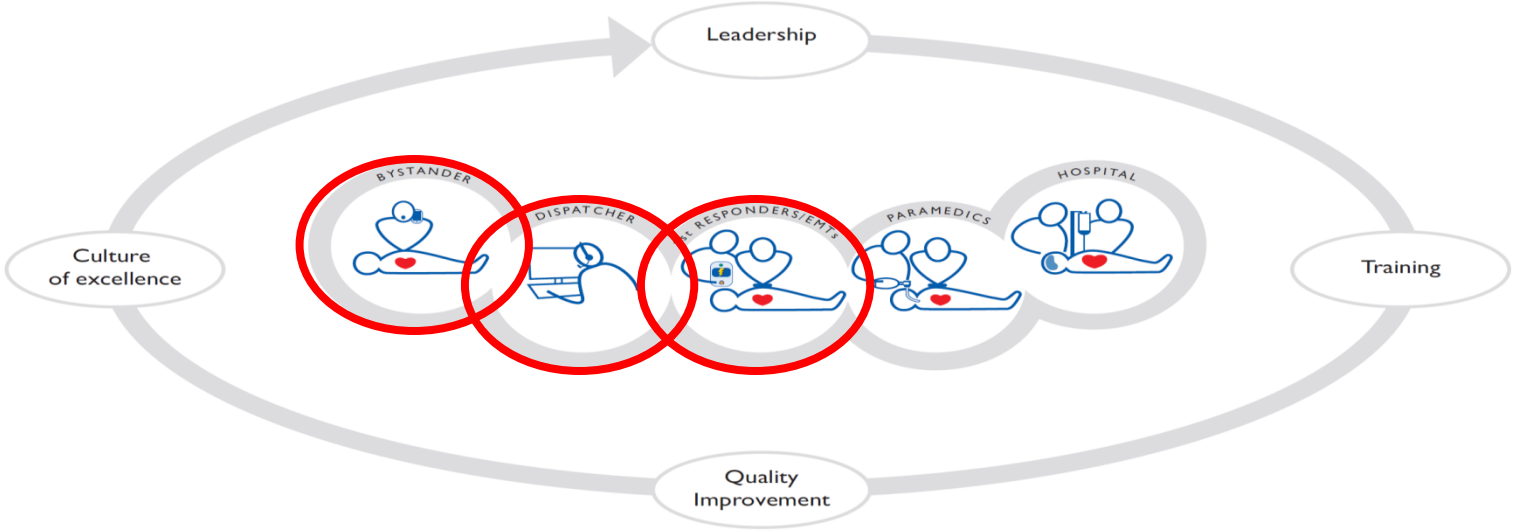
HEARTSAFE LIVING
AED ALERT SYSTEM





First AED

Quality of education and local implementation



A call to establish a Global Resuscitation Alliance, Utstein meeting, Stavanger 2015

Thank you for your attention !