Fremtidens hjertestarter bringes ud med en drone

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462
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The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

Early Cardiopulmonary Resuscitation in Out-of-Hospital Cardiac Arrest

Ingela Hasselqvist-Ax, R.N., Gabriel Riva, M.D., Johan Herlitz, M.D., Ph.D., Mårten Rosenqvist, M.D., Ph.D., Jacob Hollenberg, M.D., Ph.D., Per Nordberg, M.D., Ph.D., Mattias Ringh, M.D., Ph.D., Martin Jonsson, B.Sc., Christer Axelsson, R.N., Ph.D., Jonny Lindqvist, M.Sc., Thomas Karlsson, B.Sc., and Leif Svensson, M.D., Ph.D.

N Engl J Med. 2015 Oct 15;373(16):1573-4.

Subgroup	Survival Rate — No CPR before EMS Arrival	Survival Rate — CPR before EMS Arrival	Patients with No CPR before EMS Arrival	Patients with CPR before EMS Arrival	Odds Ratio (95% CI)
	%		*no.*		
All patients	4.0	10.5	14,869	15,512	2.80 (2.47–3.18)
Age					
≤72 yr	5.6	12.7	6,405	9,043	2.44 (2.07–2.87)
>72 yr	2.9	7.9	8,011	5,929	2.84 (2.30–3.50)
Sex					
Female	4.1				2.14 (1.67–2.73)
Male	4.1				3.02 (2.60–3.51)
Cause of cardiac arrest					
Cardiac	4.2				2.94 (2.53–3.41)
Noncardiac	3.4				2.62 (1.99–3.45)
Location of cardiac arrest					
At home	3.1				1.97 (1.64–2.37)
Other location	6.7				2.72 (2.26–3.27)
Initial ECG rhythm					
VF or VT	9.4	20.1	4,194	5,900	2.43 (2.07–2.85)
Asystole or PEA	1.5	3.2	9,487	8,394	2.12 (1.62–2.78)
Year of cardiac arrest					
1990–1995	3.8	9.7	3,892	2,629	2.75 (2.09–3.62)
1996–2001	3.0	6.9	4,697	3,563	2.38 (1.80–3.14)
2002–2007	4.6	10.7	3,562	3,923	2.46 (1.93–3.14)
2008–2011	5.5	13.4	2,562	5,278	2.64 (2.07–3.88)

Figure 2. Subgroup Analysis of Survival Rates.

ECG denotes electrocardiographic, PEA pulseless electrical activity, VF ventricular fibrillation, and VT ventricular tachycardia.

30 day survival with the use of an onsite AED

- Witnessed + presumed cardiac + shockable rhythm cases.

Resuscitation 91 (2015) 1–7

Contents lists available at ScienceDirect

Resuscitation

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

Clinical Paper

Survival after Public Access Defibrillation in Stockholm, Sweden – A striking success☆

Mattias Ringh, Martin Jonsson, Per Nordberg, David Fredman, Ingela Hasselqvist-Ax, Felicia Håkansson, Andreas Claesson, Gabriel Riva, Jacob Hollenberg*

Karolinska Institutet, Department of Medicine, Solna, Center for Resuscitation Science, Stockholm, Sweden

American Journal of Emergency Medicine xxx (2017) xxx–xxx

Contents lists available at ScienceDirect

American Journal of Emergency Medicine

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

Defibrillation before EMS arrival in western Sweden

A. Claesson [a,*], J. Herlitz [b], L. Svensson [a], L. Ottosson [c], L. Bergfeldt [c], J. Engdahl [d], C. Ericson [c], P. Sandén [c], C. Axelsson [b], A. Bremer [b]

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[b] *Department of Acute and Prehospital Care and Medical Technology, Prehospen - Centre for Prehospital Research, Prehospital Research Centre of Western Sweden, University of Borås, SE-501 90 Borås, Sweden*
[c] *Institute of Medicine, Department of Molecular and Clinical Medicine, Sahlgrenska University Hospital, SE-413 45 Gothenburg, Sweden*
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Stockholm 2006-2012:

70% (n=52/74)

VG Region Sweden 2008-2015:

68% (n=50/74)

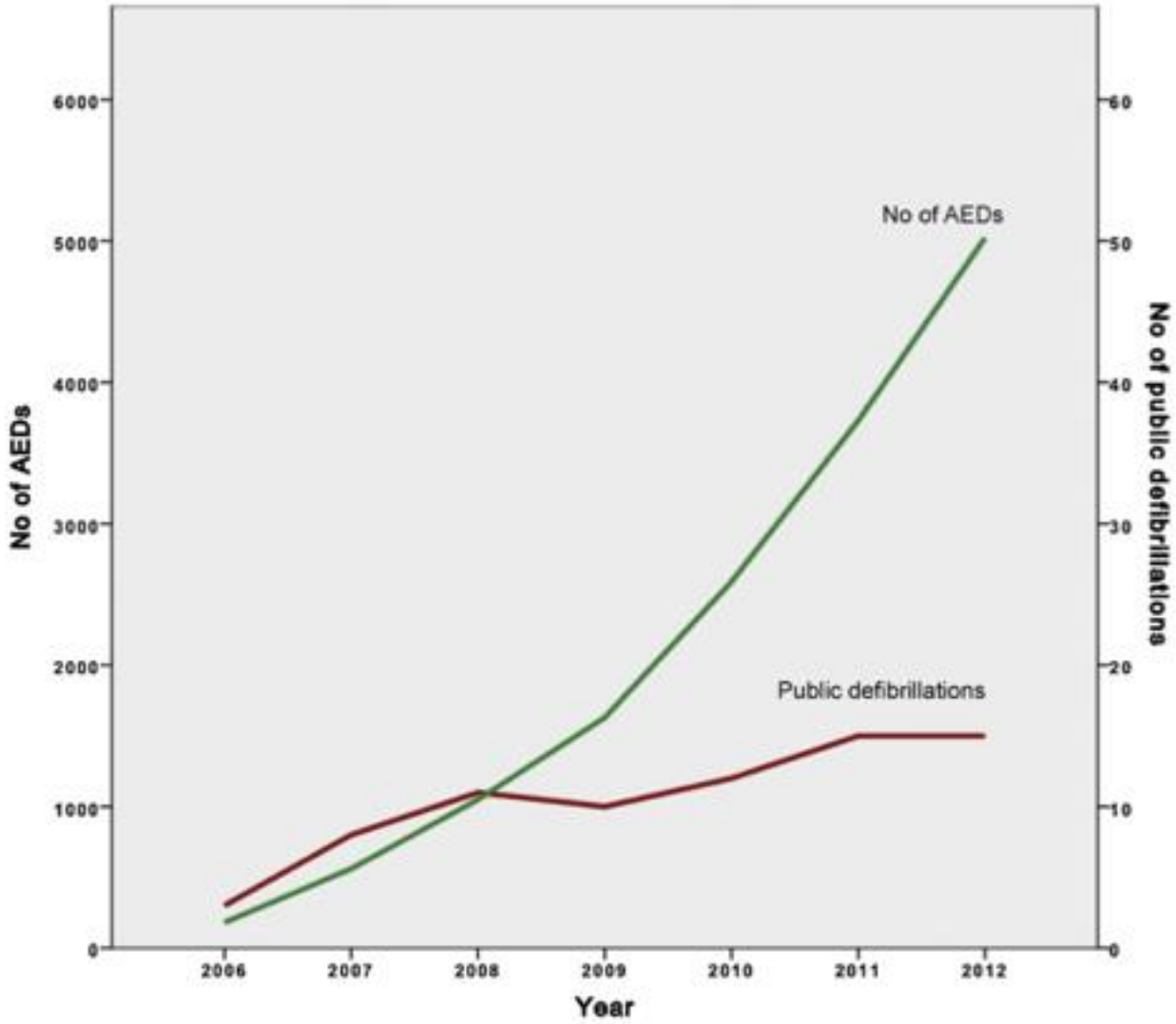

Fig. 3. Defibrillation by public AEDs (*n*) in relation to the cumulative number of public AEDs sold in Stockholm County in 2006–2012. Spearman's correlation = 0.955, $p < 0.001$.

RESUSCITATION 136 (2019) 30–37

Available online at www.sciencedirect.com

Resuscitation

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

Clinical paper

Automated external defibrillator accessibility is crucial for bystander defibrillation and survival: A registry-based study

Lena Karlsson[a,b,*], *Carolina Malta Hansen*[b,c], *Mads Wissenberg*[a,b], *Steen Møller Hansen*[d], *Freddy K. Lippert*[b], *Shahzleen Rajan*[a], *Kristian Kragholm*[d,e], *Sidsel G. Møller*[a], *Kathrine Bach Søndergaard*[a], *Gunnar H. Gislason*[a,f], *Christian Torp-Pedersen*[d,g], *Fredrik Folke*[a,b]

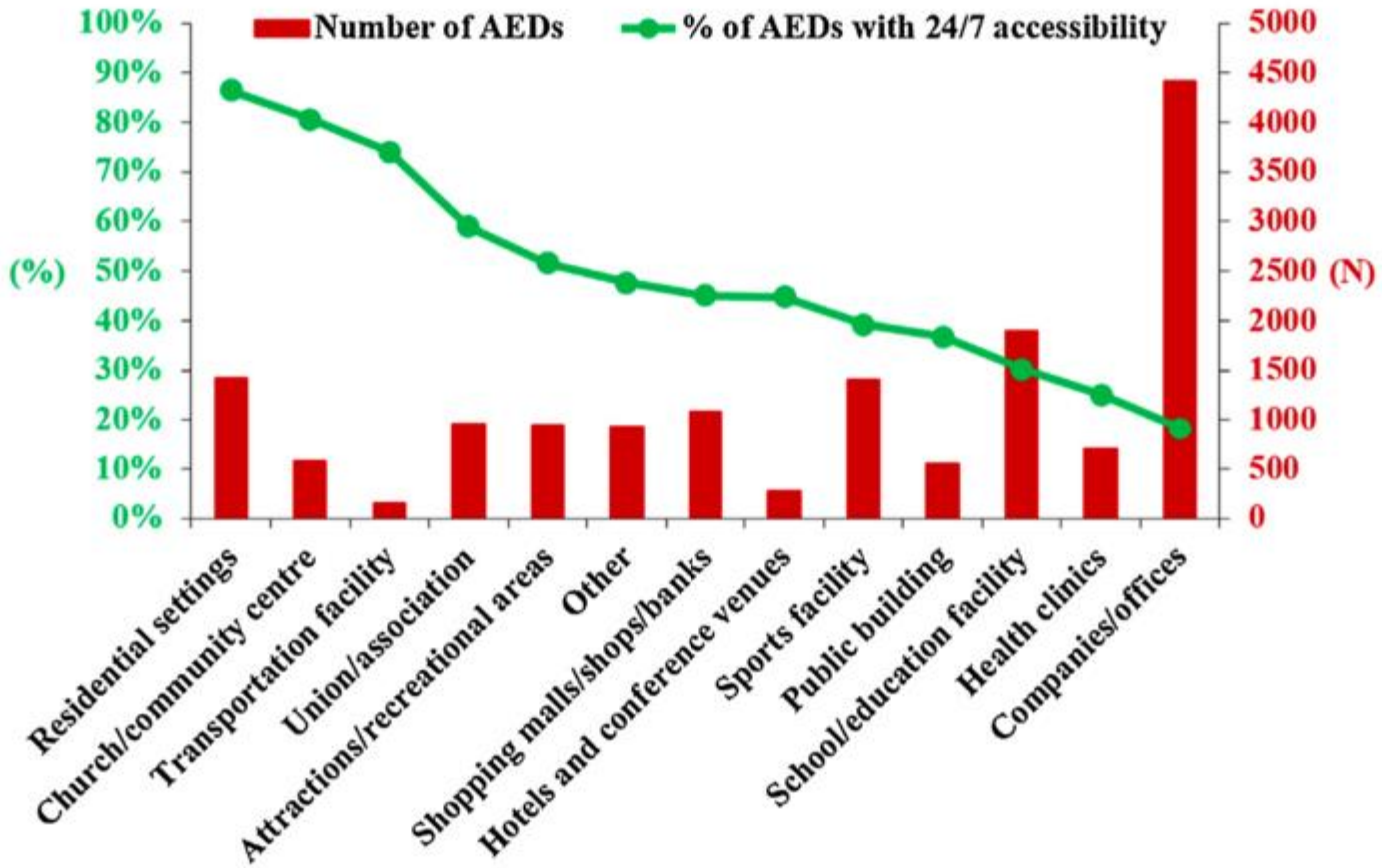

Fig. 4 – The nationwide number of registered AEDs and 24/7 accessibility, according to the type of location in 2016. AED, automated external defibrillator; 24/7, 24 h per day, 7 days per week.

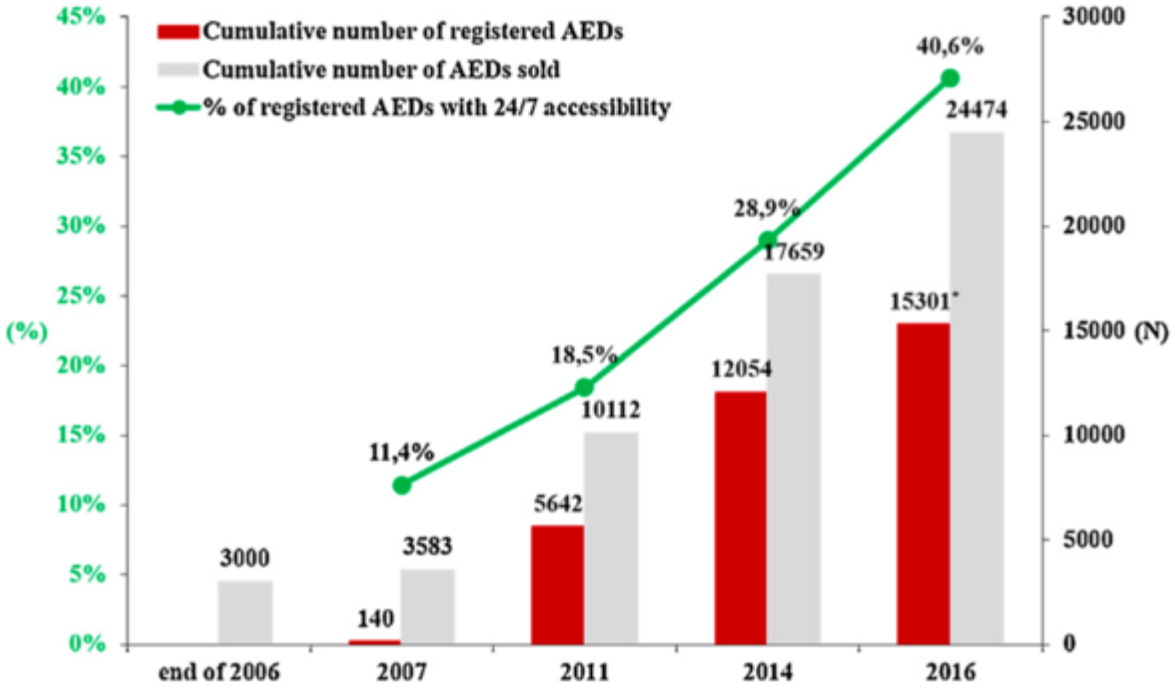

Fig. 3 – Cumulative number of all AEDs sold and registered within the nationwide Danish AED Network, and temporal changes in 24/7 AED accessibility.
***In total, 17 106 AEDs were registered with the nationwide network from 2007 through 2016, and 1805 (10.6%) of these were withdrawn during the study period (Table 3 in Ref.[20]).**
AED, automated external defibrillator; 24/7, 24 h per day, 7 days per week.

”Of 2500 OHCAs, 566 (22.6%) were covered by an AED.

About half of these (n = 276) were covered by an accessible AED at the time of OHCA”

- 11% covered AND accessible <200 meters

- Multiple bystanders (in order not to interrupt CPR) in x%?

Resuscitation 96 (2015) 303–309

Contents lists available at ScienceDirect

Resuscitation

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

Clinical Paper

The role of bystanders, first responders, and emergency medical service providers in timely defibrillation and related outcomes after out-of-hospital cardiac arrest: Results from a statewide registry☆

Carolina Malta Hansen[a,*], Kristian Kragholm[a], Christopher B. Granger[a], David A. Pearson[b], Clark Tyson[a,c], Lisa Monk[a], Claire Corbett[d], R. Darrell Nelson[e], Matthew E. Dupre[a,f], Emil L. Fosbøl[a,g], Benjamin Strauss[h], Christopher B. Fordyce[a], Bryan McNally[i,j], James G. Jollis[a]

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[i] Emory University School of Medicine, Atlanta, GA, United States
[j] Rollins School of Public Health, Emory University, Atlanta, GA, United States

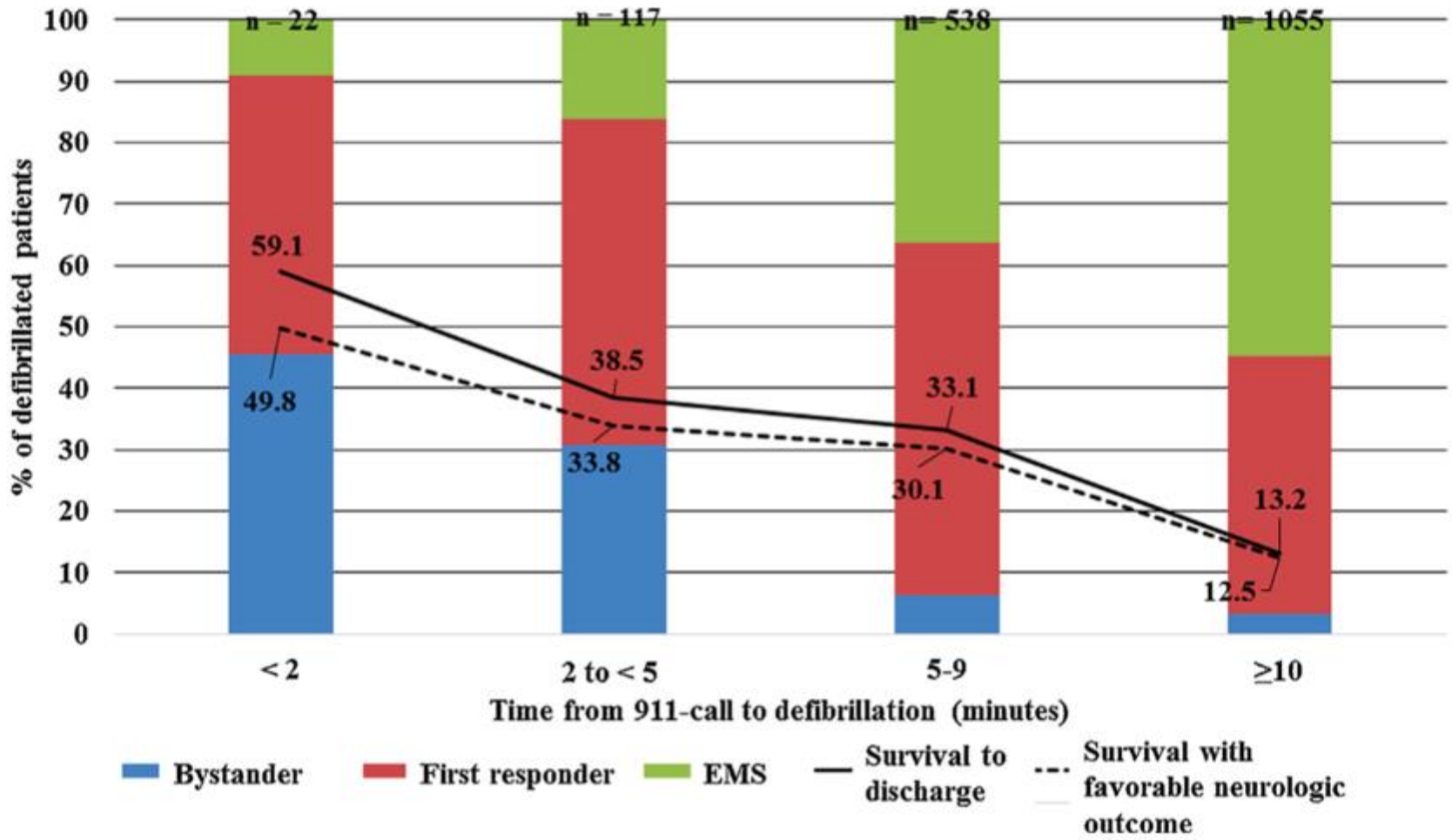
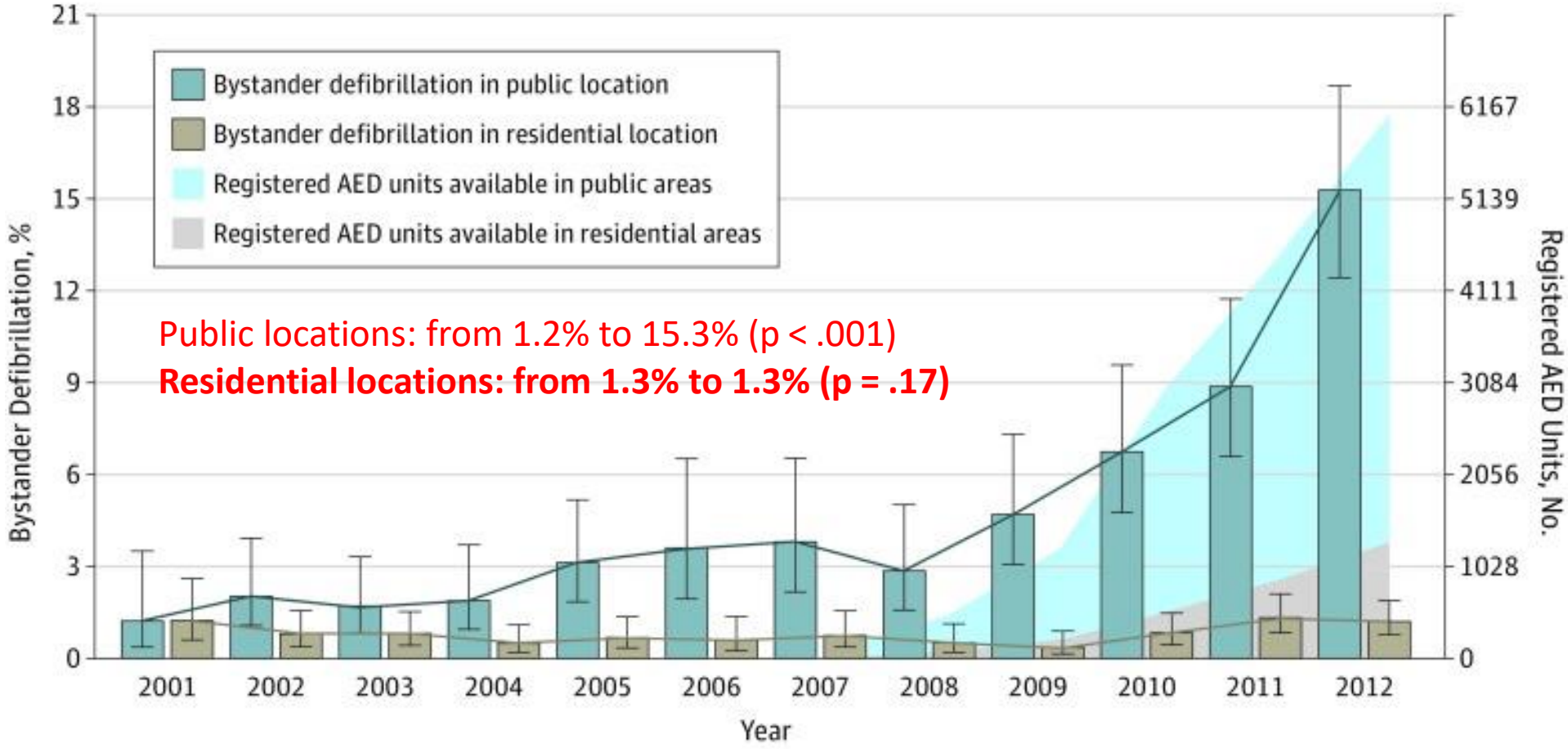


Fig. 2. Time to defibrillation and survival to discharge according to who performed defibrillation. The figure shows survival to discharge and survival with favorable neurologic outcome (good cerebral performance and moderate cerebral disability) according to time from 911-call to defibrillation and who performed defibrillation. EMS, emergency medical services.

Bystander Defibrillation for Out-of-Hospital Cardiac Arrest in Public vs Residential Locations

Hansen SM et al. JAMA Cardiol. 2017 May; 2(5): 507–514.

- Totally 18 688 patients with OHCA in Denmark between 2001-2012 (67.8% men):



Claesson *et al. Scandinavian Journal of Trauma, Resuscitation and Emergency Medicine* (2016) 24:124
DOI 10.1186/s13049-016-0313-5

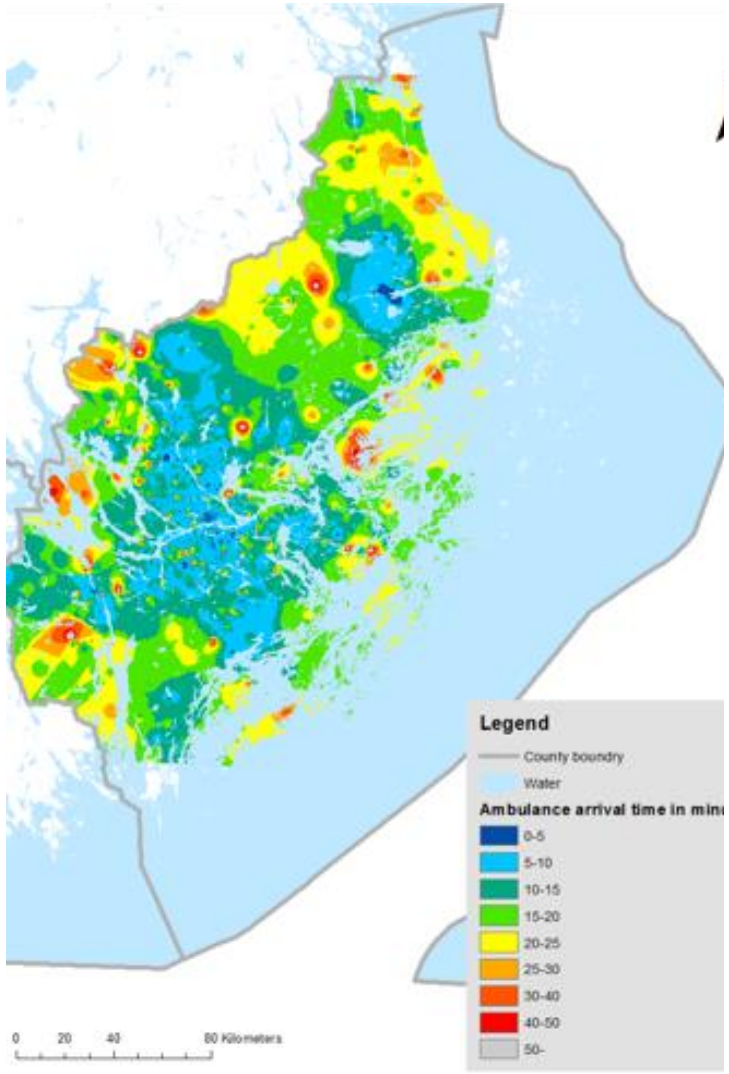
Scandinavian Journal of Trauma, Resuscitation and Emergency Medicine

ORIGINAL RESEARCH Open Access

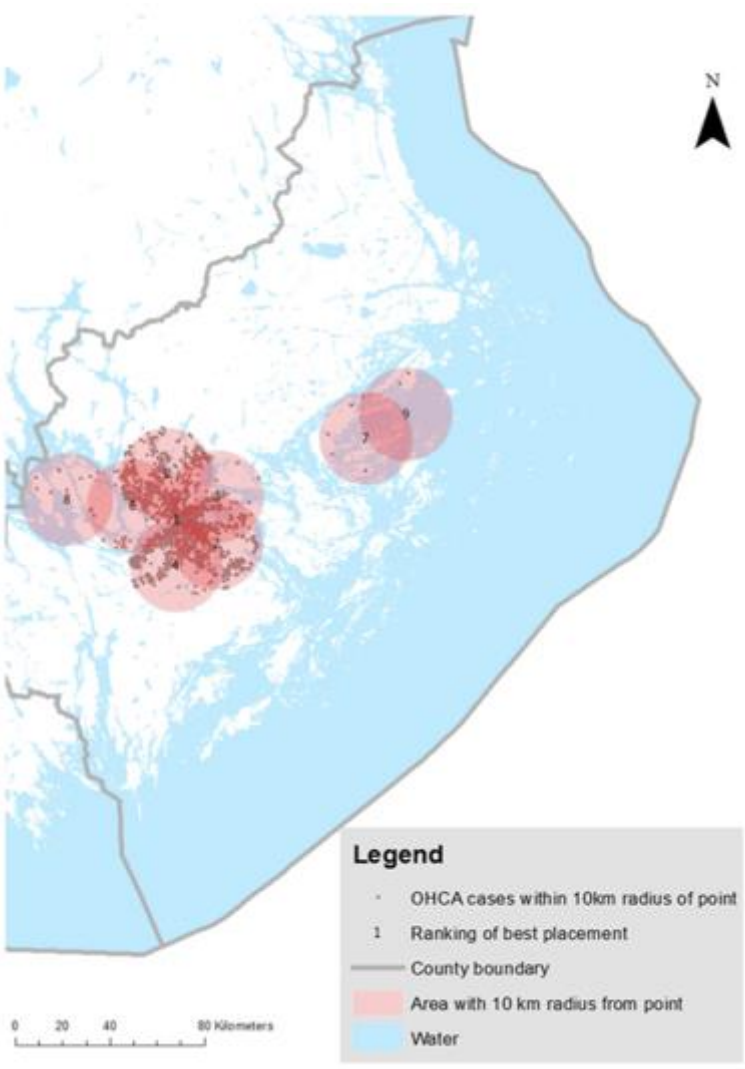
Unmanned aerial vehicles (drones) in out-of-hospital-cardiac-arrest

A. Claesson[1*], D. Fredman[1], L. Svensson[1], M. Ringh[1], J. Hollenberg[1], P. Nordberg[1], M. Rosenqvist[2], T. Djarv[1], S. Österberg[1], J. Lennartsson[3] and Y. Ban[3]

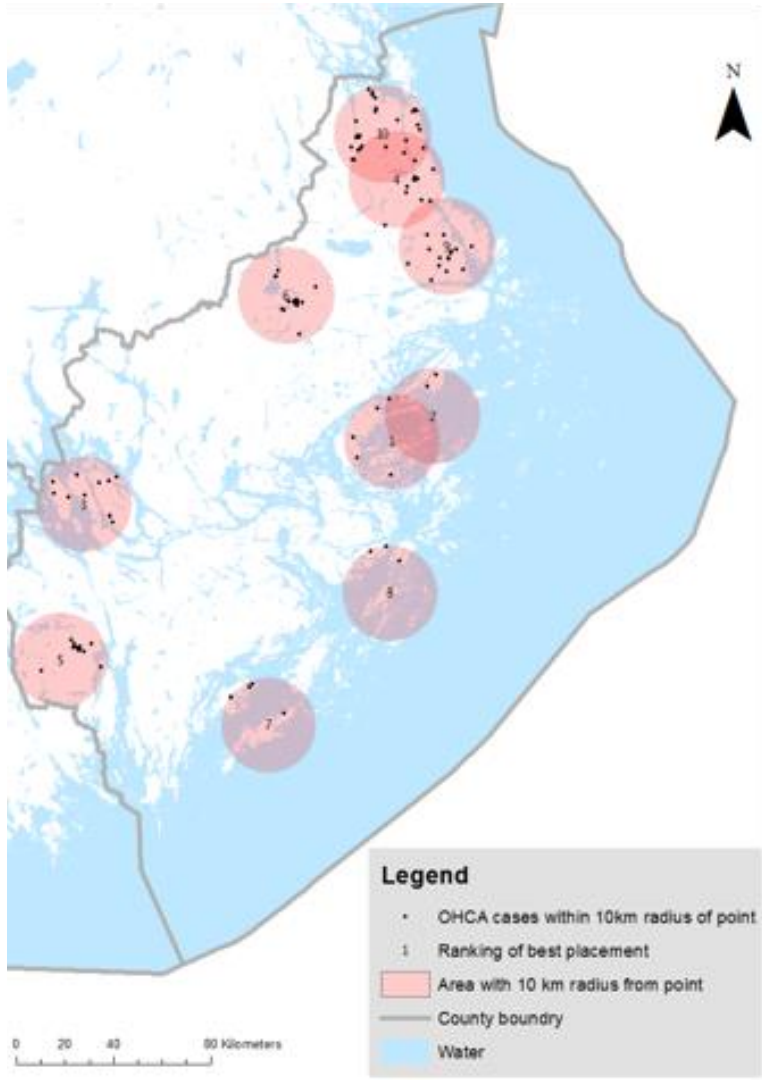
A. EMS response time



B. 50/50 weighting



C. 80/20 weighting



Results GIS-model

Urban areas - 10 optimal locations

UAV arrived prior to EMS in 32 % of all cases (n=3041) in urban areas.

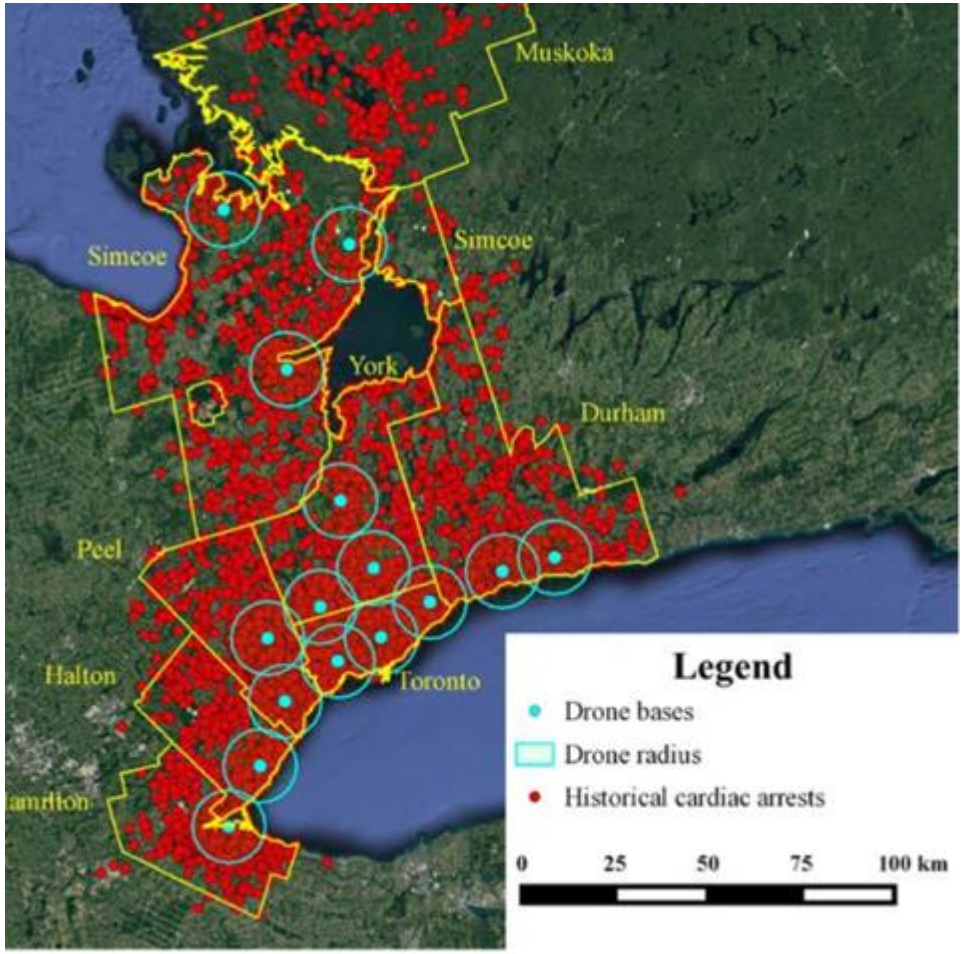
Median timesaving: 1.5 minutes.

Rural areas - 10 optimal locations

UAV arrived prior to EMS in 93% of all cases (n=124) in rural areas

Median timesaving: 19 minutes.

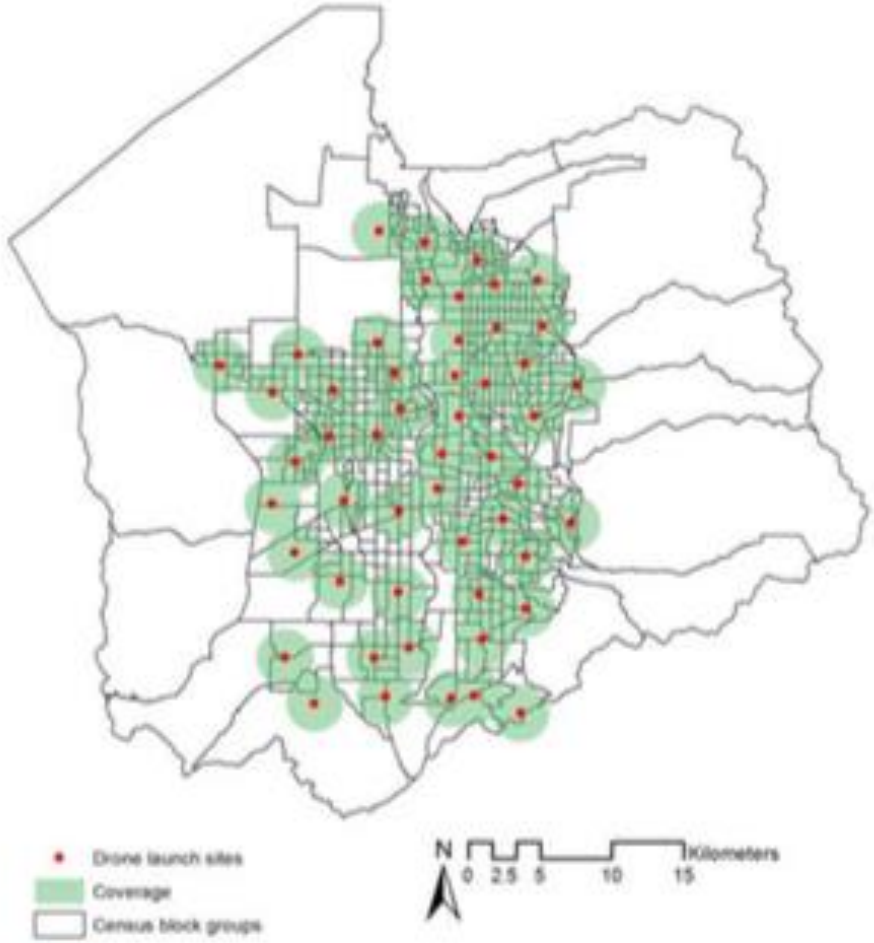
Boutilier J et al, Circulation. 2017;135:2454–2465 – Toronto (CA)



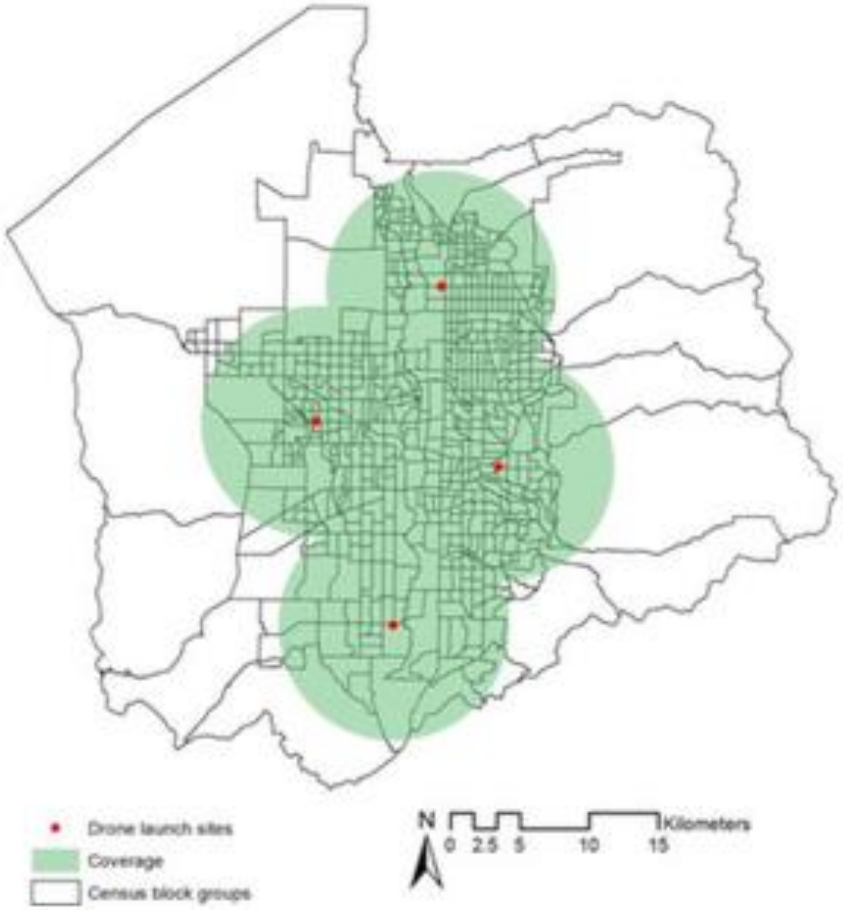
- Totally 81 bases and 100 drones would be required to deliver an AED ahead of median 911 response times by 3 minutes.

Pulver et al, Prehosp emerg care 2016 - Salt lake city (US)

1 min flight-time - 51 systems
= 80,1% OHCA coverage



5 min flight-time - 4 systems
= 94,1% OHCA coverage

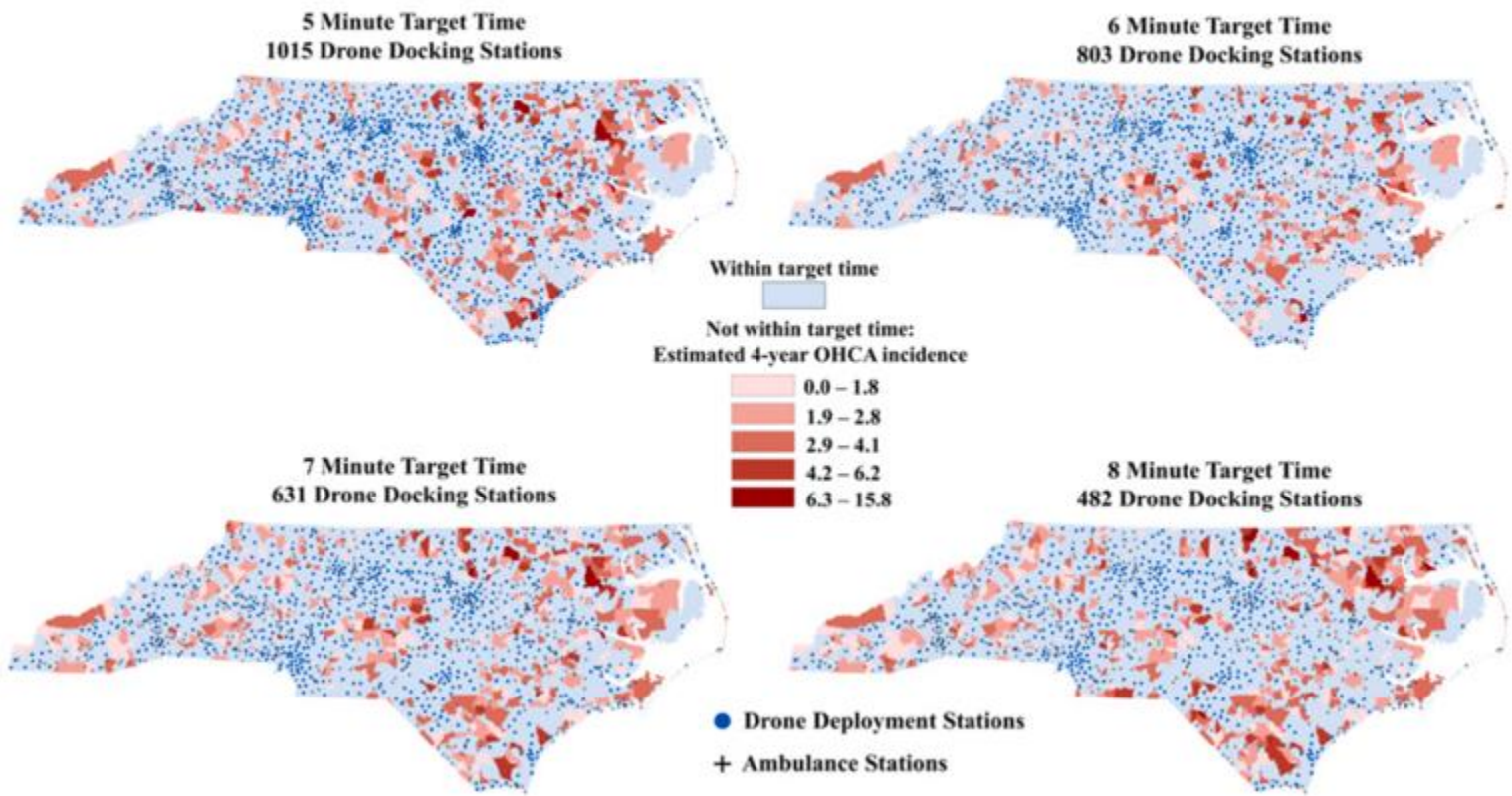


The Case for Drone-assisted Emergency Response to Cardiac Arrest:
An Optimized Statewide Deployment Approach

Brittany Bogle, Wayne D. Rosamond, Kyle T. Snyder, Jessica K. Zègre-Hemsey

NCMJ VOL. 80, NO. 4
NCMEDICALJOURNAL.COM

FIGURE 2.
North Carolina Census Block Groups Expected to Have an AED Delivered ≤ Specified Target Time ≥ Target Time for the Maximum Number of Drone Docking Stations Necessary to Cover Block Groups within the Specified Target Time




UAS


HJÄRTSTARTARE - AED


2380

JAMA
The Journal of the American Medical Association

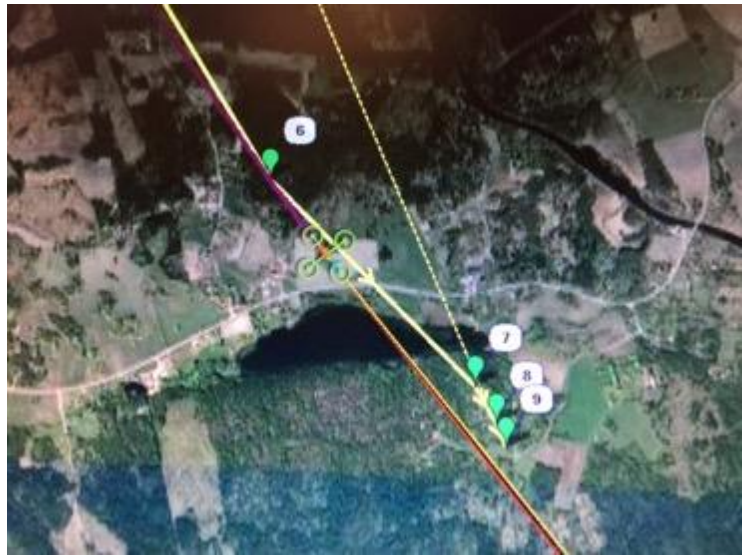
Karolinska Institutet

Claesson A, Bäckman A, Ringh M, Svensson L, Nordberg P, Djärv T, Hollenberg J.

Time to Delivery of an Automated External Defibrillator Using a Drone for Simulated Out-of-Hospital Cardiac Arrests vs Emergency Medical Services. JAMA.2017 Jun 13;317(22):2332-2334.

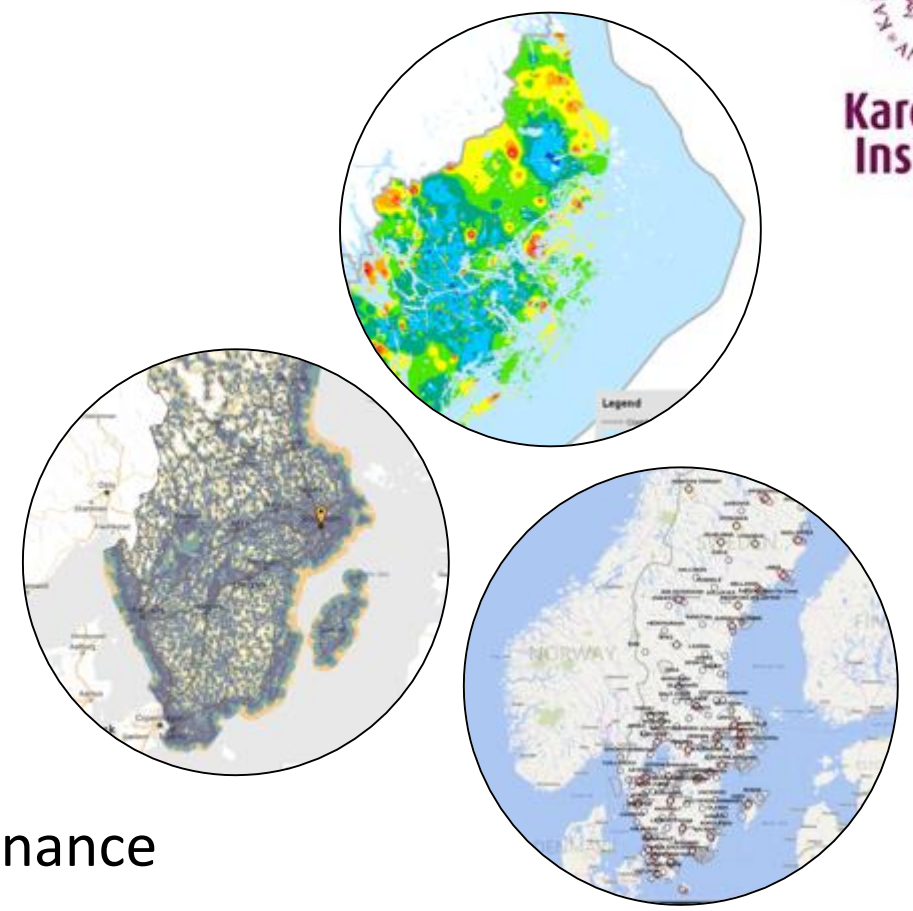
The median time from dispatch to arrival of the drone was **5:21 minutes** (IQR, 3:03-8:33) **vs 22:00 minutes** (IQR, 17:48-29:00) for ambulance services.

*The drone arrived more quickly in all cases with **a median reduction in response time of 16:39 minutes** (95% CI, 13:48-20:12; P < .001).*



Optimal placement depending on

- Incidence OHCA, xx/100.000/year
- EMS / UAS response time/reach
- Mobile network 4G (5G)/ LTE coverage
- No fly zones, restricted areas
- Geographical, meteorological conditions
- Infrastructure, predictive management, maintenance

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PITCHUP


5G
ERICSSON
5G

Sanfridsson et al. Scandinavian Journal of Trauma, Resuscitation and Emergency Medicine (2019) 27:40
https://doi.org/10.1186/s13049-019-0622-6

Scandinavian Journal of Trauma, Resuscitation and Emergency Medicine

ORIGINAL RESEARCH Open Access

Drone delivery of an automated external defibrillator – a mixed method simulation study of bystander experience

J. Sanfridsson[1], J. Sparrevik[2], J. Hollenberg[1], P. Nordberg[1], T. Djärv[1], M. Ringh[1], L. Svensson[1], S. Forsberg[1], A. Nord[1], M. Andersson-Hagiwara[3] and A. Claesson[1*]

Three categories of bystander experiences emerged:

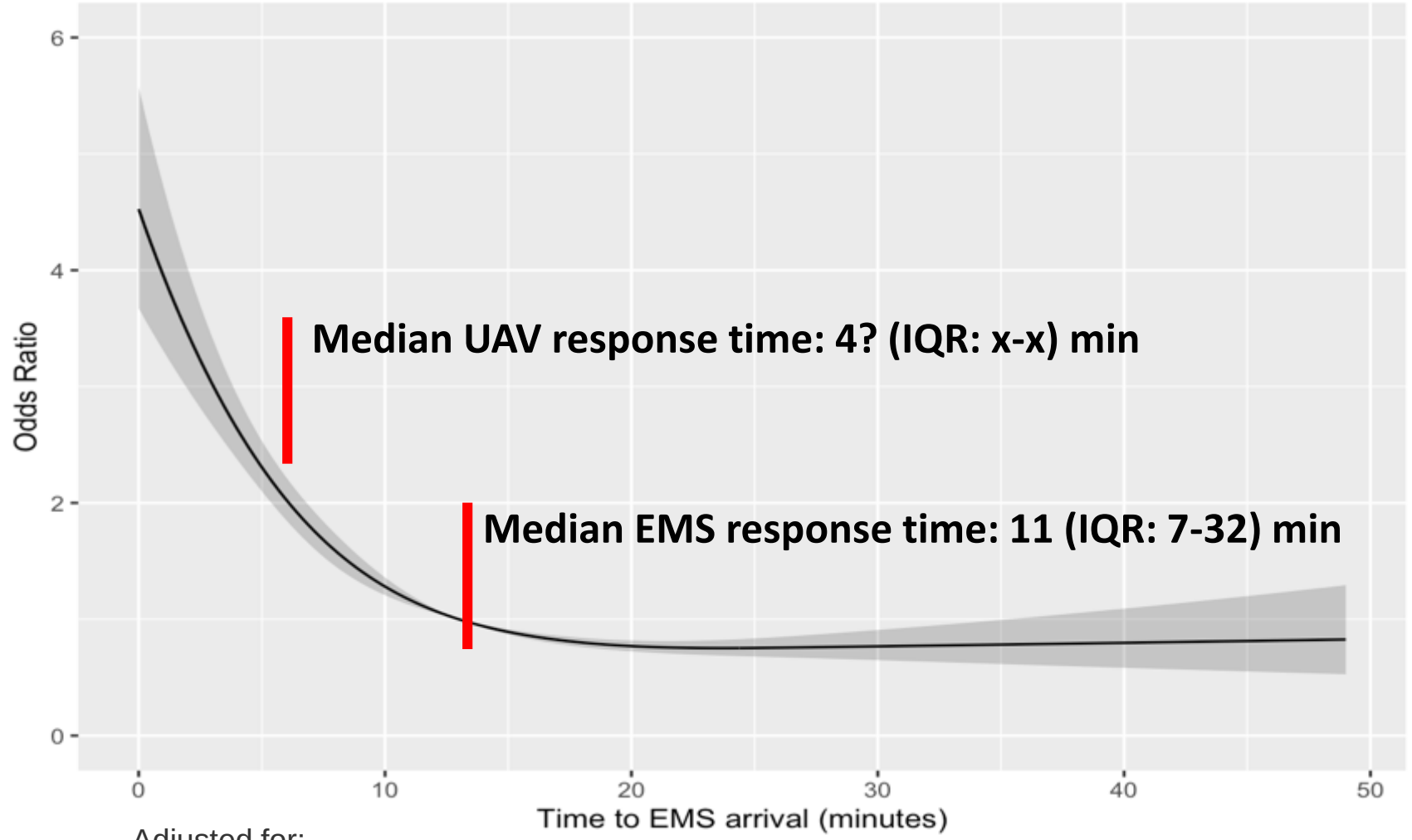
1) Technique and preparedness,
2) Support through conversation with the dispatcher
3) Aid and decision-making.

- "The main finding was that retrieval of an AED as delivered by a drone was experienced as safe and feasible for bystanders. "

Fig. 4 Photo of participant retrieving AED as delivered by a drone. Photo of participant retrieving AED (Schiller FRED easyportTM) after drone (a modified DJI Inspire 1) delivered AED 50 meters from the manikin and then hovered above at 10 m altitude, marking the location of the AED and provided livestream video to local dispatcher

Adjusted odds ratio for 30-days survival in relation to CPR and EMS reponse time (call to arrival) - Sweden 2008-2017, n= 48,322 cases

- in manus



Adjusted for:
EMS delay, bystander CPR, age, sex, cause of arrest, witnessed status, place of arrest

Conclusion

- Timesaving benefits in OHCA as compared to EMS
- Optimal locations / safety/ feasibility /costs and bystander - drone - EMCC interaction needs further evaluation
- EASA legislations soon to come
- Potential in UAV-technology for other conditions
- National GIS study ongoing and Clinical study to be launched

Fremtidens hjertestarter bringes ud med en drone

andreas.claesson@ki.se

Video: https://youtu.be/qKE2ZUqmGzE

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