Epidemiology of out of hospital cardiac arrest – how to improve survival

Prof Gavin Perkins

Co-Chair ILCOR

Chair, Community Resuscitation Committee, Resuscitation Council (UK)

Conflict of interest

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- Commercial – nil
- Academic
  - National Institute for Health Research funding to conduct clinical trials in cardiac arrest
  - BHF / RCUK support for OHCAO registry
  - Co-Chair ILCOR
  - BLS/AED roles (ILCOR, ERC, RCUK)
  - Editor Resuscitation

Outline

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- National Out of Hospital Cardiac Arrest Registry
- Epidemiology of cardiac arrest
- Chain of survival
- System approaches to improving survival from cardiac arrest
- Research, audit and quality improvement

OHCAO

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National Out of Hospital Cardiac Arrest Outcomes Project

ASSOCIATION OF AMBULANCE CHIEF EXECUTIVES

NASMeD
National Ambulance Service Medical Directors

Open Access Protocol

BMJ Open

The UK Out of Hospital Cardiac Arrest Outcome (OHCAO) project

Gavin D Perkins, Samantha J Brace-McDonnell, On behalf of the OHCAO Project Group

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ABSTRACT

Introduction: Reducing premature death is a key priority for the UK National Health Service (NHS). NHS Ambulance services treat approximately 30 000 cases of suspected cardiac arrest each year but survival rates vary. The British Heart Foundation and Resuscitation Council (UK) have funded a structured research programme—the Out of Hospital Cardiac Arrest Outcomes (OHCAO) programme. The aim of the project is to establish the epidemiology and outcome of OHCA, explore sources of variation in outcome and establish the feasibility of setting up a national OHCA registry.

Methods and analysis: This is a prospective observational study set in UK NHS Ambulance Services. The target population will be adults and children sustaining an OHCA who are attended by an NHS ambulance emergency response and where resuscitation is attempted. The data collected will be characterised broadly as system characteristics, emergency medical services (EMS) dispatch characteristics, patient characteristics and EMS process variables. The main outcome variables of interest will be return of spontaneous circulation and medium—long-term survival (30 days to 10-year survival).

Ethics and dissemination: Ethics committee permissions were gained and the study also has received approval from the Confidentiality Advisory Group Ethics and Confidentiality committee which provides authorisation to lawfully hold identifiable data on patients without their consent. To identify the key characteristics contributing to better outcomes in some ambulance services, reliable and reproducible systems need to be established for collecting data on OHCA in the UK. Reports generated from the registry will focus on data completeness, timeliness and quality. Subsequent reports will summarise demographic, patient, process and outcome variables with aim of improving patient care through focus quality improvement initiatives.

Strengths and limitations of this study

- Successful accomplishment of objectives highly likely to improve understanding and improve outcomes from UK population, and potential to influence national policy and procedures.
- This is a unique opportunity to study the impact of 'process' on national patient outcomes.
- The development of operational procedures, standardised data collection processes and data definitions.
- Reliance on already stretched National Health Service (NHS) resources.

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INTRODUCTION

Reducing premature death is a key priority for the National Health Service (NHS).[1 2] NHS Ambulance Services treat approximately 30 000 patients a year for out of hospital cardiac arrest. There is significant variability between ambulance services in rates of the reported successful initial resuscitation (15–27%) and survival to hospital discharge (2–12%).[3] Nichol *et al* identified evidence of regional variation in incidence and outcomes from OHCA in 10 North American sites. There was more than 100% variability in incidence (rates ranging from 71 to 160/100 000 population) and similar variability in the decision to start resuscitation. Of those patients where resuscitation was started by the emergency medical service (EMS) there was marked variation in survival rates (range 3.0–16.3%, with a median of 8.4% (IQR, 5.4–10.4%).[4]

Differences in outcomes may occur due to random variation (so called common-cause variation) or due to non-random/special cause variation. The former is to be expected in any process or system, while the latter is a systematic or unexpected deviation from the norm and may highlight an area worthy of further investigation. Evaluation of the English ambulance services return of spontaneous circulation (ROSC) and survival to discharge rates suggests there may be special cause variation (see figure 1).

Potential explanations for special cause variability

Lilford *et al*[5] describes a pyramid with five causes of non-random/special variation in health outcomes (data, case mix, structure,

British Heart Foundation

NHS
National Institute for Health Research

Resuscitation Council (UK)

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YOU CAN'T IMPROVE WHAT YOU DON'T MEASURE.

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TRIALS UNIT

ILCOR Consensus Statement

Cardiac Arrest and Cardiopulmonary Resuscitation Outcome Reports: Update of the Utstein Resuscitation Registry Templates for Out-of-Hospital Cardiac Arrest

Perkins GD, Jacobs J, Nadkarni V et al 2015

OHCAO

Out of Hospital Cardiac Arrest Outcomes

Epidemiology Report

Report for the period
January - December 2015, for the
West Midlands Ambulance Service NHS Foundation Trust

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Resuscitation Council (UK)

British Heart Foundation

OHCAO

Foreword

When the Department of Health published its Cardiovascular Disease Outcomes Strategy in 2013 it included the aspiration of saving 1000 additional lives each year for those suffering out of hospital cardiac arrest (OHCA).

One of the key steps in achieving that goal has been to establish a better understanding of the epidemiology, pathways of care and outcomes following OHCA.

We commend the initiative shown by the National Association of Ambulance Medical Directors for their vision in supporting the establishment of a national registry for OHCA, and acknowledge the support of the Resuscitation Council (UK), British Heart Foundation and University of Warwick in realising this. Progress made over the last 3 years has enabled this document, the 2nd epidemiology and outcomes report for England, to be published.

The information in this report provides important insights into the epidemiology and outcome of cardiac arrest in each region. Findings should be shared with Ambulance Trust Boards, commissioners and patient and public partners. Scrutiny of these data will assist the development of quality improvement initiatives to optimise the "Chain of Survival".

Nationally, the Community Resuscitation Steering Group – a collective of stakeholder organisations – has helped support best practice and is set to launch a consensus document "Resuscitation to Recovery : A National Framework to improve the care of people with Out-of-Hospital Cardiac Arrest in England". The OHCAO registry is positioned to play a key role in evaluating the success of many collective efforts, and the continuing support of all those involved is commended and appreciated.

Together we can make a difference.

Professor Huon Gray,
National Clinical Director for Heart Disease, NHS England

Professor Jonathon Benger,
National Clinical Director for Urgent Care, NHS England

OHCAO

4.3.3 EMS response time

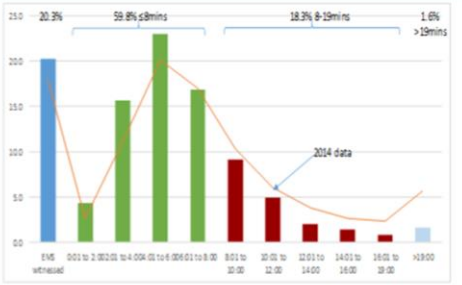

Figure 11: Arrival time of Emergency Medical Services to OHCA events in 2015.

Studies have shown that the chances of survival decrease significantly the longer it takes the EMS to arrive at the location of the OHCA. Ambulance response times have long been known to be independently associated with defibrillation and survival in OHCAs (Pell et al. 2001), and the recommended response time is 8-minutes. In the UK, a study of the effect of reducing ambulance response times (ART) Pell and her colleagues observed that a reduction in the 90th centile ART from 15 to 8-minutes resulted in an 8% increase in the number of potential survivors. Reducing ARTs to 5-minutes was observed to almost double the survival rate for cardiac arrests not witnessed by ambulance crews.

Figure 11 presents details of the arrival time of EMS personal to an OHCA in W MAS. For any cardiac arrest that was first witnessed by EMS personnel the arrival time was changed to 0 minutes. About 50% of all non-EMS witnessed OHCAs were reached in under 8-minutes. After 8-minutes there was an exponential decline in the proportion of cases with arrival time, however, approximately 2% of cases were still not reached after 19-minutes. The reason for the latter is unknown. These could include cases where cardiac arrest was not recognized at the time of the emergency call leading to a lower response category. It is also possible that it includes patients who sustained a cardiac arrest after the initial 999 call was made. Just under 60% of all OHCA incidents were reached in under 8-minutes, with a further 20.3% witnessed at the scene. Approximately 18.3% of cases were reached between 8 and 19-minutes. The corresponding figures for 2014 were 18.0%, 51.0% and 25.3%. We therefore observe an improvement in the proportion of OHCA cases that are reached in the recommended time.

Case-mix adjustment

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Prediction of Out-of-Hospital Cardiac Arrest in England

Word count: 2,999

Introduction

Out-of-hospital cardiac arrest (OHCA) is a leading cause of cardiac related death in developed countries with only 7.6% of patients surviving to hospital discharge.[1] However, in recent years several countries and regions have made major advances in the improvement of survival rates from OHCA: 25% patients in Stanvanger, Norway survived to hospital discharge[2] and 21% in Seattle[3] and Northern Netherlands.[4]

In England, approximately 30,000 cases are treated annually by emergency medical services (EMS).[5] However, survival outcomes, including return of spontaneous circulation (ROSC) at hospital transfer and survival to hospital discharge, have achieved limited progress. Recent data from English ambulance services indicate that one in four patients can achieve ROSC at hospital transfer, while the survival to hospital discharge rate is still around 8%,[5,6] with regional variation reported between 2%-12%.[7] Improving the management of OHCA is part of the Department of Health's Cardiovascular Disease Outcomes strategy,[8] and the British Heart Foundation (BHF), Resuscitation Council UK (RCUK) and NHS England are committed to improving OHCA survival outcomes in England.[9,10]

Recent studies have recognised a range of case-mix and process factors in non-UK populations that are associated with OHCA survival outcomes. These include: location of OHCA, patient age and gender;[11-15] witnessed status, bystander cardiopulmonary resuscitation (CPR);[1,12-14] initial cardiac arrest rhythm;[11-13,16] patient ethnicity, public access defibrillator (PAD) use;[14] and EMS response time.[17]

The relative contribution of each of these factors to survival varies according to the situation and from country-to-country. In addition, only a few studies have assessed the

Model validation

The performance of the predictive models of both survival outcomes were shown in Table 5. Calibration, discrimination and overall performance were reduced in the validation data for both models. The hospital survival model outperformed the ROSC model regarding AUC and Brier's score. The AUC values showed that the hospital survival model produced fair prediction while the ROSC model was less well predictive. The Cox calibration regression produced a positive intercept with an overall positive 95% confidence intervals for the ROSC model, which indicated significant global under-prediction. The calibration plots in Figure 1 showed deviation from the diagonal line for the ROSC model. Concentration of observed probabilities in the lower tensile for the survival to hospital transfer model also reflected poorer calibration in the validation data for both models.

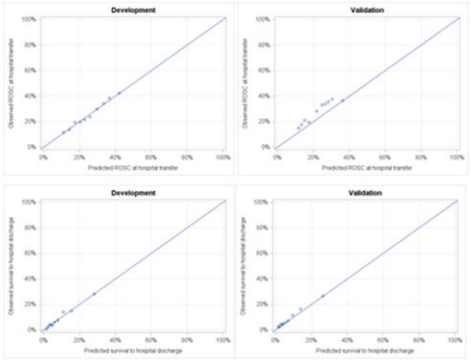
Table 5: Performance of prediction models in the development and validation data

Model Performance		Development	Validation
ROSC at hospital transfer	AUC (95% CI)	0.648 (0.636, 0.660)	0.614 (0.604, 0.624)
	Cox Calibration Regression		
	Intercept (95% CI)	0.008 (-0.092, 0.108)	0.139 (0.036, 0.241)
	Slope (95% CI)	1.008 (0.920, 1.096)	0.880 (0.798, 0.958)
	Hosmer-Lemeshow test	10.2 (0.254)	68.9 (<0.001)
	Brier's score	0.180	0.197
Survival at hospital discharge	AUC (95% CI)	0.765 (0.748, 0.781)	0.740 (0.725, 0.754)
	Cox Calibration Regression		
	Intercept (95% CI)	0.024 (-0.153, 0.201)	-0.137 (-0.285, 0.012)
	Slope (95% CI)	1.012 (0.933, 1.090)	0.878 (0.818, 0.939)
	Hosmer-Lemeshow test	113.7 (<0.001)	125.0 (<0.001)
	Brier's score	0.071	0.072

Note: 1) AUC: area under the curve or c-statistic. The closer the AUC gets to 1, the better the model is. 2) Cox Calibration regression: model is perfectly calibrated if intercept=0 and slope=1. 3) Hosmer-

Note: 1) AUC: area under the curve or c-statistic. The closer the AUC gets to 1, the better the model is. 2) Cox Calibration regression: model is perfectly calibrated if intercept=0 and slope=1. 3) Hosmer-Lemeshow test assesses model's goodness of fit. A small Chi-square with p>0.05 is considered good fit. 4) Brier score assesses the overall accuracy of model prediction. A low score (close to 0) indicates close agreement between observed and predicted values.

Figure 1: Observed vs predicted probability of ROSC at hospital transfer and survival to hospital discharge



Data linkage

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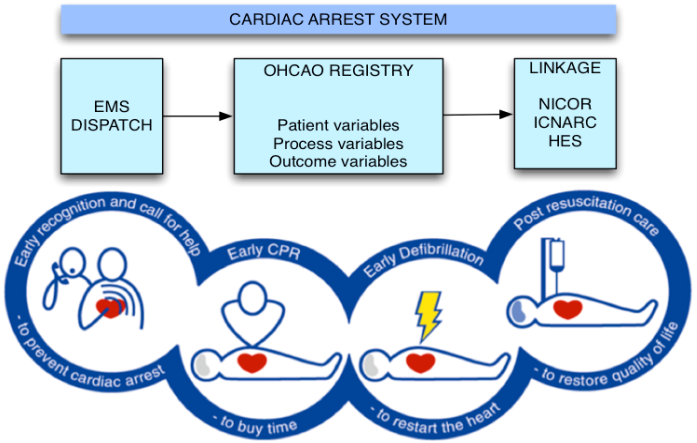
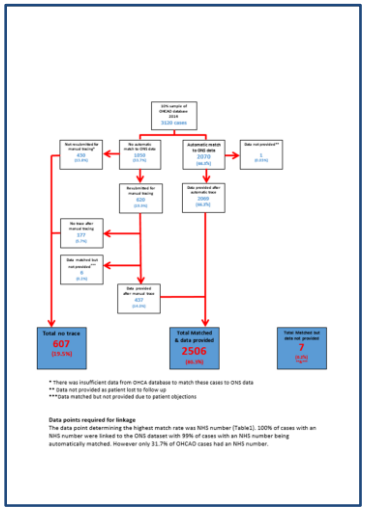
OHCAO

NICOR

NHS Digital

icnarc | intensive care national audit & research centre





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Clinical paper

EuReCa ONE—27 Nations, ONE Europe, ONE Registry
A prospective one month analysis of out-of-hospital cardiac arrest outcomes in 27 countries in Europe☆

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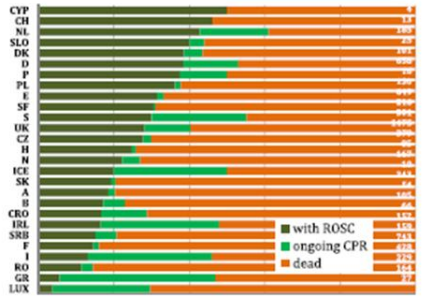
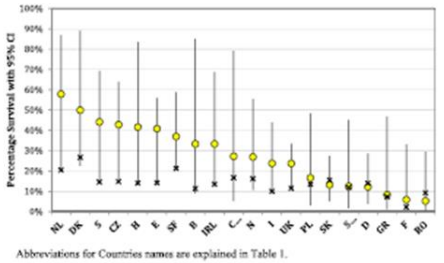


Abbreviations: ROSC= Return of spontaneous circulation, CPR= cardiopulmonary resuscitation, Abbreviations for Countries names are explained in Table 1.
*Patients included in the "Dead" category either died at scene or were pronounced dead on arrival at hospital. Numbers to the right of each bar represent the total number of cases per country.

Fig. 3. Status on hospital admission ($n = 6884$)*. *Abbreviations:* ROSC = Return of spontaneous circulation; CPR = cardiopulmonary resuscitation; Abbreviations for countries names are explained in Table 1. *Patients included in the "Dead" category either died at scene or were pronounced dead on arrival at hospital. Numbers to the right of each bar represent the total number of cases per country.



Abbreviations for Countries names are explained in Table 1.

Fig. 5. Hospital survival rate in the Utstein Comparator Group (cardiac cause, shockable rhythm, and collapse bystander witnessed). Hospital survival data was available for 733 patients (seven countries with less than 10 cases were excluded: Austria, Cyprus, Iceland, Luxembourg, Portugal, Slovenia, Switzerland; $n = 25$). The vertical lines represent the 95% confidence intervals. The percentage of patients per country who belong to the Utstein Comparator Group is marked with 'X'.
Abbreviations for Countries names are explained in Table 1.

Outcomes for the Utstein comparator group

The Utstein comparator group included patients with a bystander witnessed arrest of suspected cardiac cause and an initial recorded shockable rhythm. In 12.5% of patients (890/7146), all criteria for the Utstein comparator were available (Supplement S2). Seven countries with less than ten patients in the Utstein comparator group were excluded (25 cases). Information on ROSC was available for 845 (98%) of these cases. The overall proportion of ROSC was 56.8%, ranging from 25.0% to 84.6% between countries. Data on survival was available for 733 patients (85%) (Fig. 5). Of these patients, 218 (29.7%) survived for at least 30 days or to hospital discharge. Survival ranged between 5.3% and 57.9%. The incidence rate of survival ranged from 0.1 survivors to 6.3 survivors

Discussion

This is the first study reporting incidence, community involvement (as bystander CPR), and outcomes following OHCA in 27 European countries. Assuming that the rate of OHCA was similar during the remaining eleven months of the year, we found an incidence rate of 84 per 100,000 population. A previous study reported 87.4 OHCAs per 100,000 person-years for Europe.[21] Thus, our results suggest that the incidence of OHCA in Europe is in the range of what has previously been reported.

We found the overall incidence of OHCA where CPR was started to be 49 patients per 100,000 population. This Fig. includes EMS and bystander treated cardiac arrests. It is clearly higher than previously reported from Europe ten years ago (38.0 per 100,000).[1] On the other hand, our findings are in good agreement with more recent data from national surveys in Denmark and Sweden.[9,10] In our study, for both these estimates, there was substantial variability between countries which may reflect a variation in disease, reporting bias or a natural variability which will be commented upon in the Limitations Section.

Collaborations

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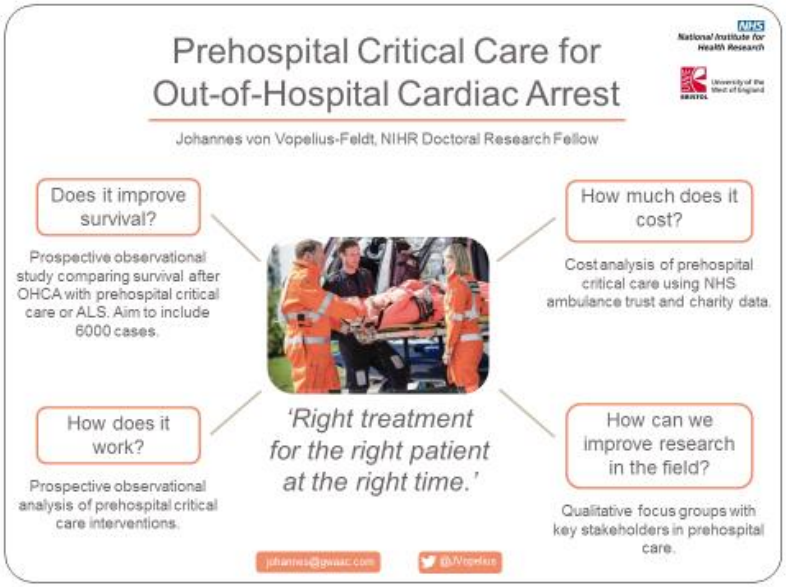
EuReCa TWO European Registry of Cardiac arrest



EUROPEAN RESUSCITATION COUNCIL

German Resuscitation Registry
Deutsches Reanimationsregister
ARREST
OHSCAR

NUI Galway
OÉ Gaillimh
OHCAR
National Out-of-Hospital Cardiac Arrest Register
OHCAO

Austrian Resuscitation Council
Österreichischer Rat für Wiederbelebung
HART VOOR LIMBURG
Luxembourg Resuscitation Council

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Clinical paper

Epidemiology and outcomes from out-of-hospital cardiac arrests in England☆

Claire Hawkes[a], Scott Booth[a], Chen Ji[a], Samantha J. Brace-McDonnell[a,b], Andrew Whittington[a], James Mapstone[j], Matthew W. Cooke[a], Charles D. Deakin[c], Chris P. Gale[d], Rachael Fothergill[e], Jerry P. Nolan[f], Nigel Rees[g], Jasmeet Soar[h], A. Niroshan Siriwardena[i], Terry P. Brown[a], Gavin D. Perkins[a,b,*], on behalf of OHCAO collaborators[1]

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ABSTRACT

Introduction: This study reports the epidemiology and outcomes from out-of-hospital cardiac arrest (OHCA) in England during 2014.

Methods: Prospective observational study from the national OHCA registry. The incidence, demographic and outcomes of patients who were treated for an OHCA between 1st January 2014 and 31st December 2014 in 10 English ambulance service (EMS) regions, serving a population of almost 54 million, are reported in accordance with Utstein recommendations.

Results: 28,729 OHCA cases of EMS treated cardiac arrests were reported (53 per 100,000 of resident population). The mean age was 68.6 (SD= 19.6) years and 41.3% were female. Most (83%) occurred in a place of residence, 52.7% were witnessed by either the EMS or a bystander. In non-EMS witnessed cases, 55.2% received bystander CPR whilst public access defibrillation was used rarely (2.3%). Cardiac aetiology was the leading cause of cardiac arrest (60.9%). The initial rhythm was asystole in 42.4% of all cases and was shockable (VF or pVT) in 20.6%. Return of spontaneous circulation at hospital transfer was evident in 25.8% (n= 6302) and survival to hospital discharge was 7.9%.

Conclusion: Cardiac arrest is an important cause of death in England. With less than one in ten patients surviving, there is scope to improve outcomes. Survival rates were highest amongst those who received bystander CPR and public access defibrillation.

☆ A Spanish translated version of the abstract of this article appears as Appendix in the final online version at http://dx.doi.org/10.1016/j.resuscitation.2016.10.030.

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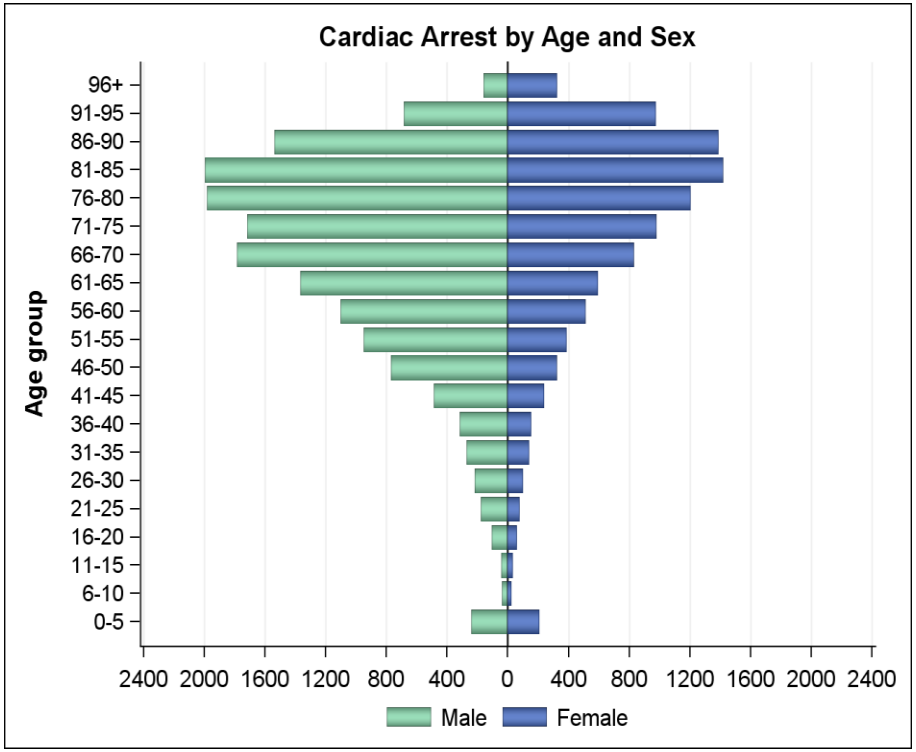
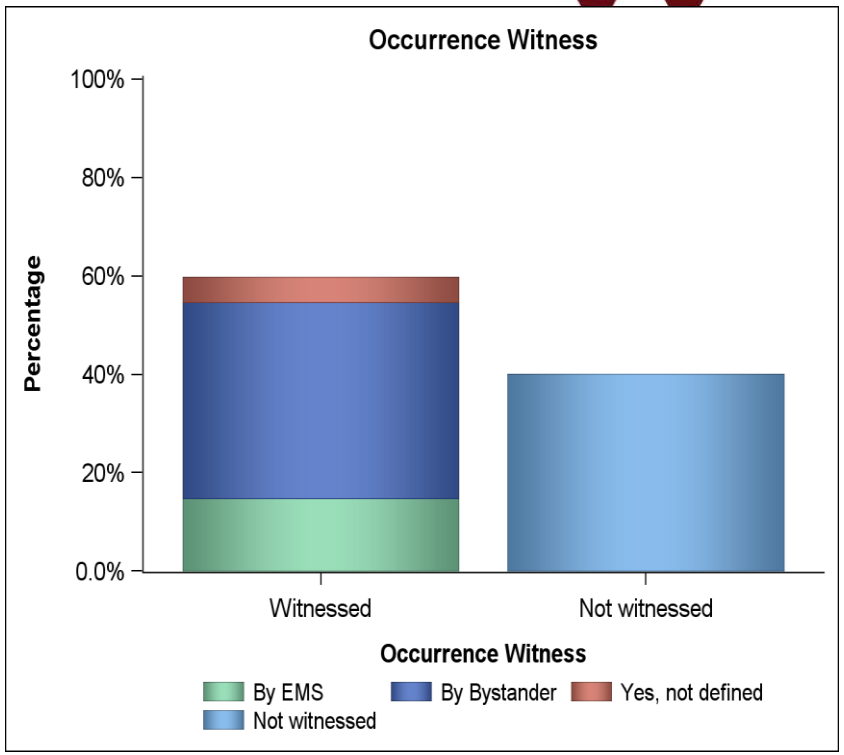
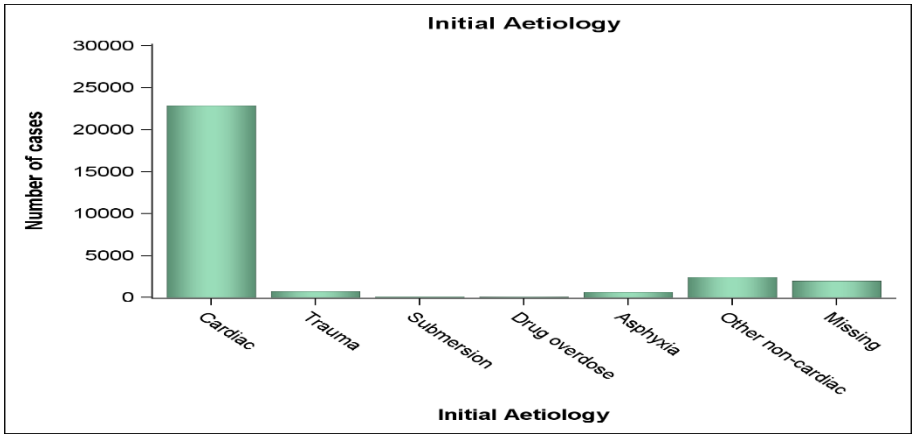
http://dx.doi.org/10.1016/j.resuscitation.2016.10.030
0300-9572/

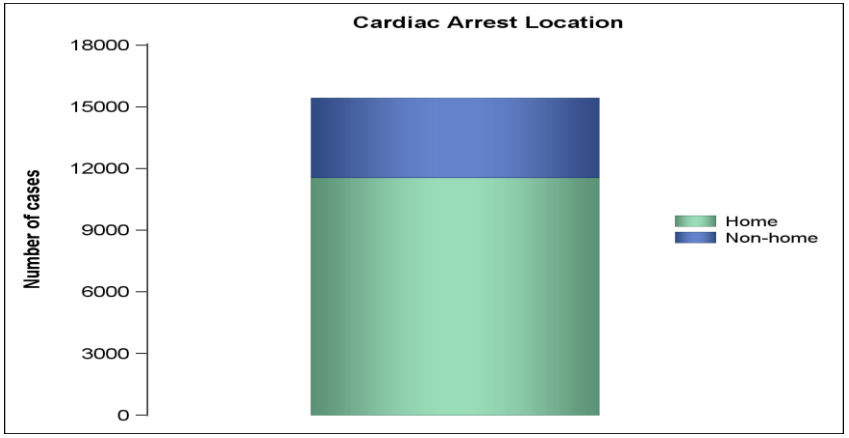
- 28,000 cardiac arrests
- 25.8% ROSC
- 7.9% survival to discharge

OHCAO

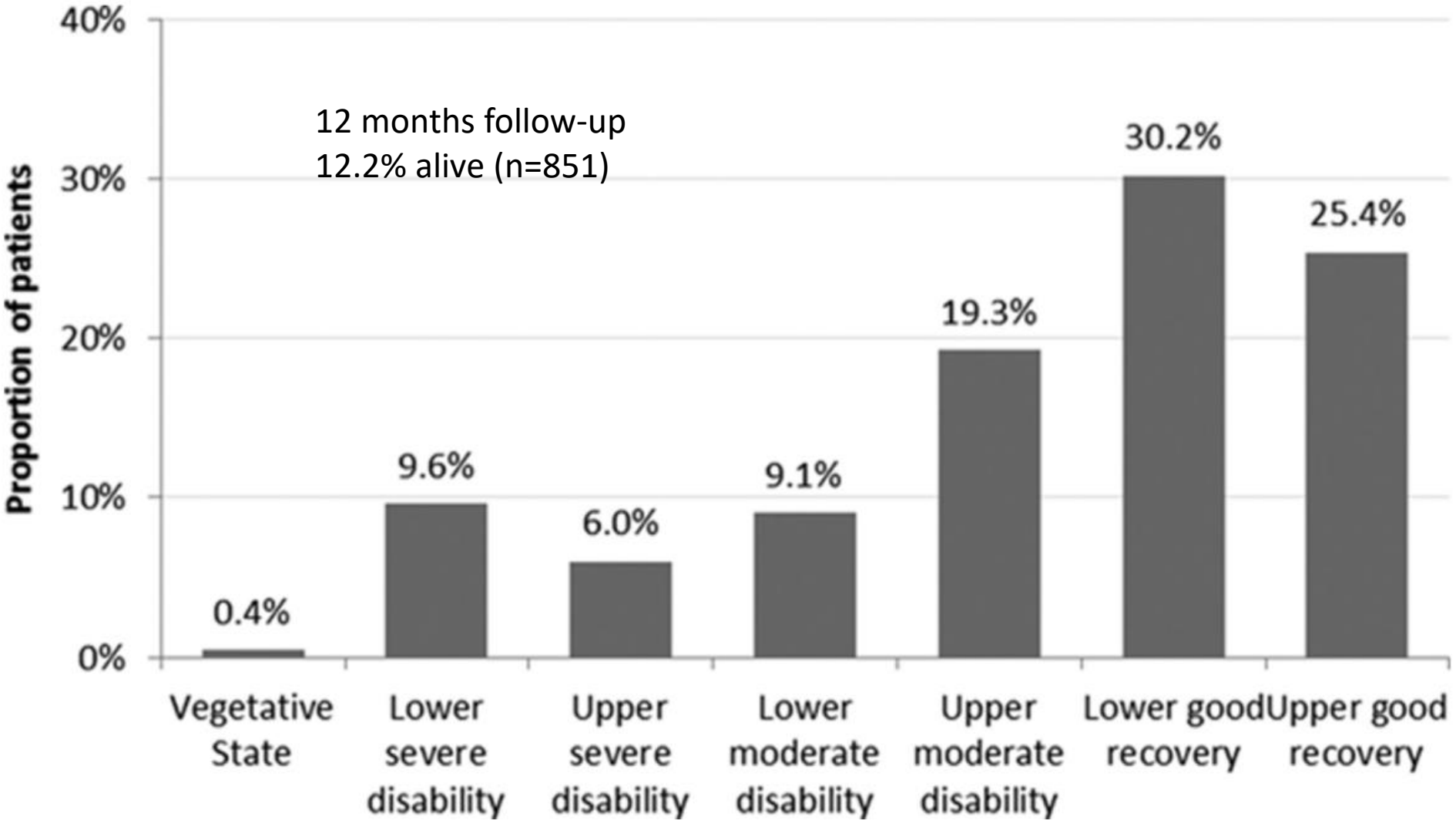

Cardiac Arrest by Age and Sex
Age group
96+
91-95
86-90
81-85
76-80
71-75
66-70
61-65
56-60
51-55
46-50
41-45
36-40
31-35
26-30
21-25
16-20
11-15
6-10
0-5
2400 2000 1600 1200 800 400 0 400 800 1200 1600 2000 2400
Male
Female


Occurrence Witness
Percentage
100%
80%
60%
40%
20%
0.0%
Witnessed
Not witnessed
Occurrence Witness
By EMS
By Bystander
Yes, not defined
Not witnessed


Initial Aetiology
Number of cases
30000
25000
20000
15000
10000
5000
0
Cardiac
Trauma
Submersion
Drug overdose
Asphyxia
Other non-cardiac
Missing
Initial Aetiology

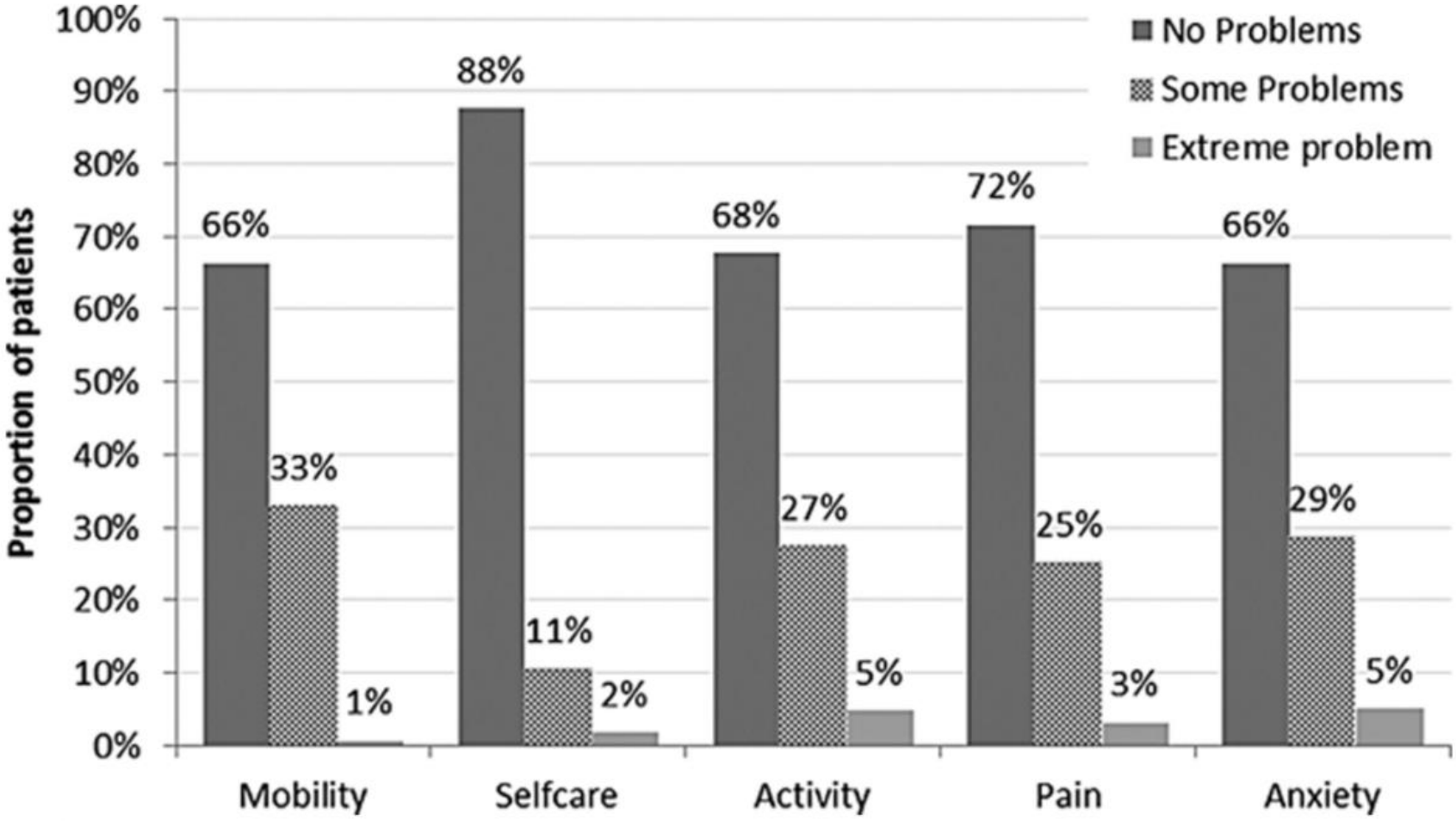

Cardiac Arrest Location
Number of cases
18000
15000
12000
9000
6000
3000
0
Home
Non-home

Quality of survival



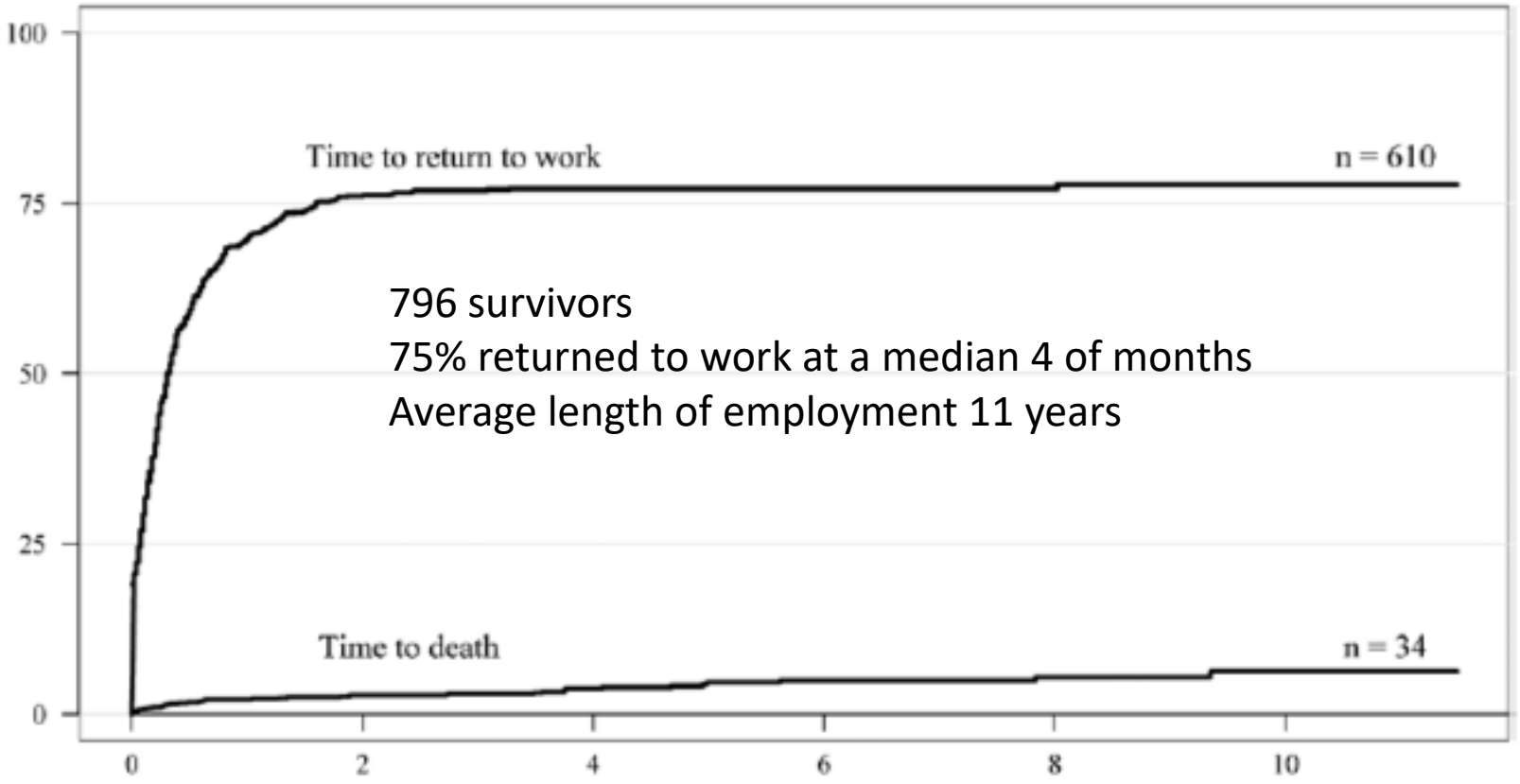
Smith Circulation 2016

Quality of survival



Smith Circulation 2016

Return to work

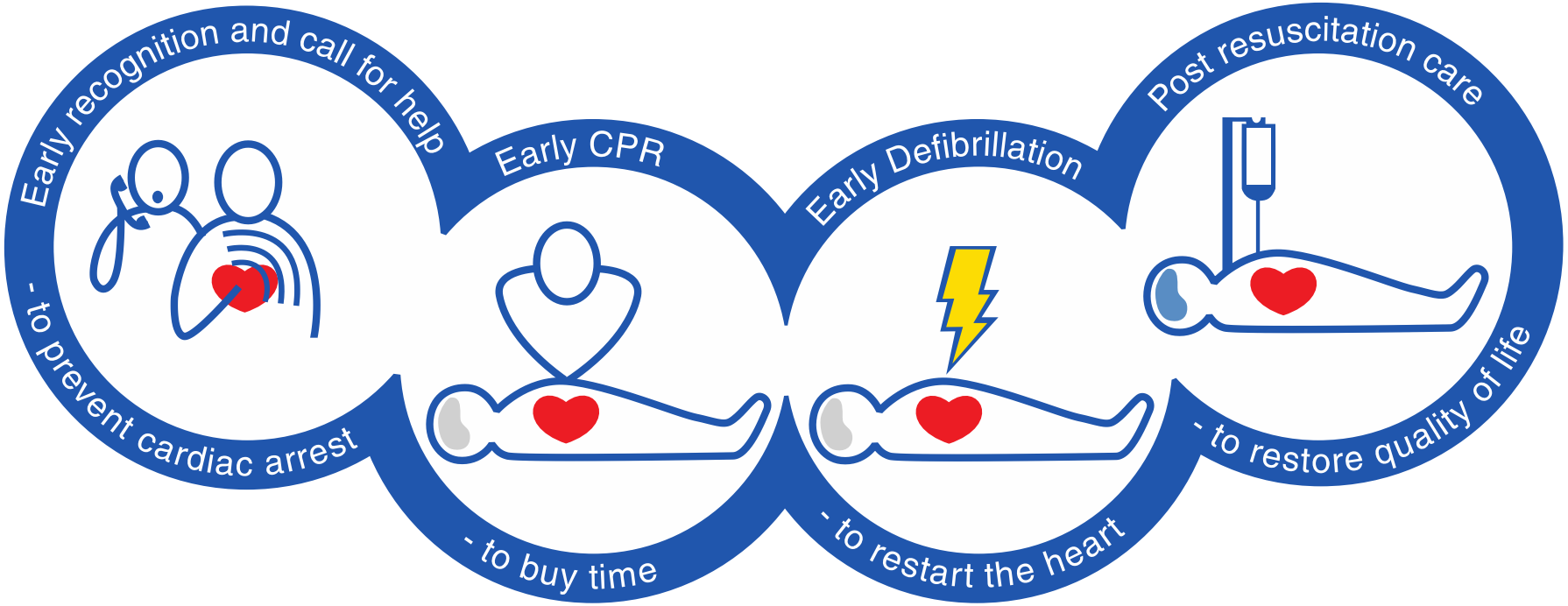


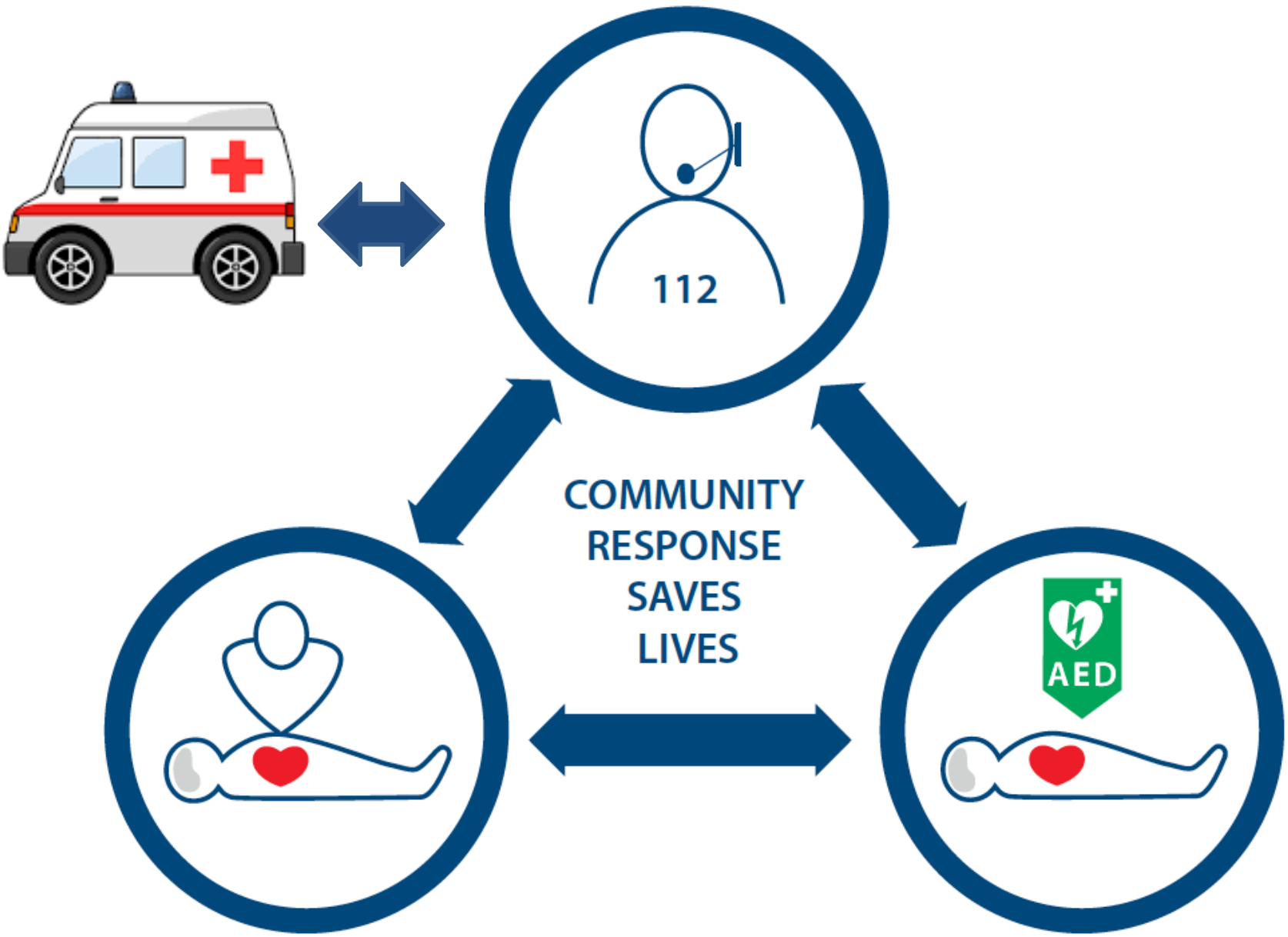
796 survivors
75% returned to work at a median 4 of months
Average length of employment 11 years

Kragholm Circulation 2015

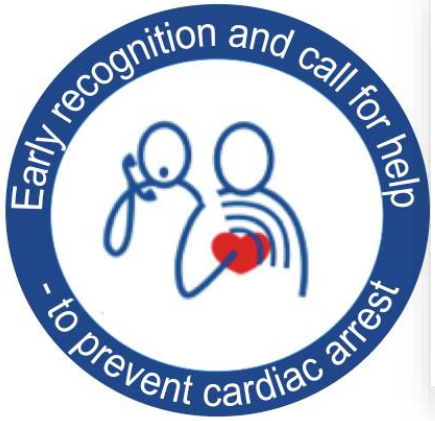
WARWICK

CLINICAL TRIALS UNIT





Perkins GD et al, *Resuscitation* 2015, 95:81-99

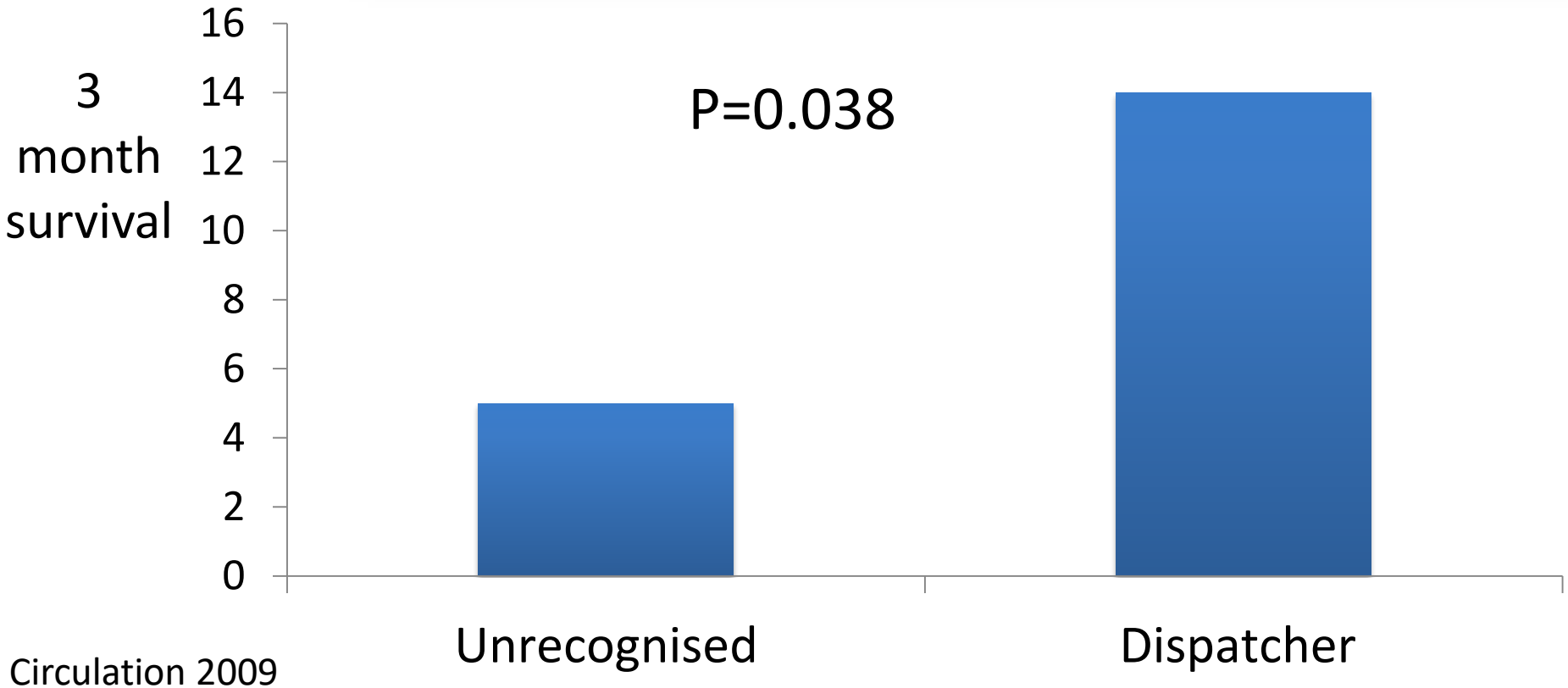


Resuscitation Science

Importance of the First Link

Description and Recognition of an Out-of-Hospital Cardiac Arrest in an Emergency Call

Jocelyn Berdowski, MS, MSE; Freerk Beekhuis, RN; Aeilko H. Zwinderman, PhD; Jan G.P. Tijssen, PhD; Rudolph W. Koster, MD, PhD



Circulation 2009

Clinical paper

Briefer activation time is associated with better outcomes after out-of-hospital cardiac arrest☆

Graham Nichol*, Leonard A. Cobb, Lihua Yin, Charles Maynard, Michele Olsufka, Jonathan Larsen, Andrew M. McCoy, Michael R. Sayre

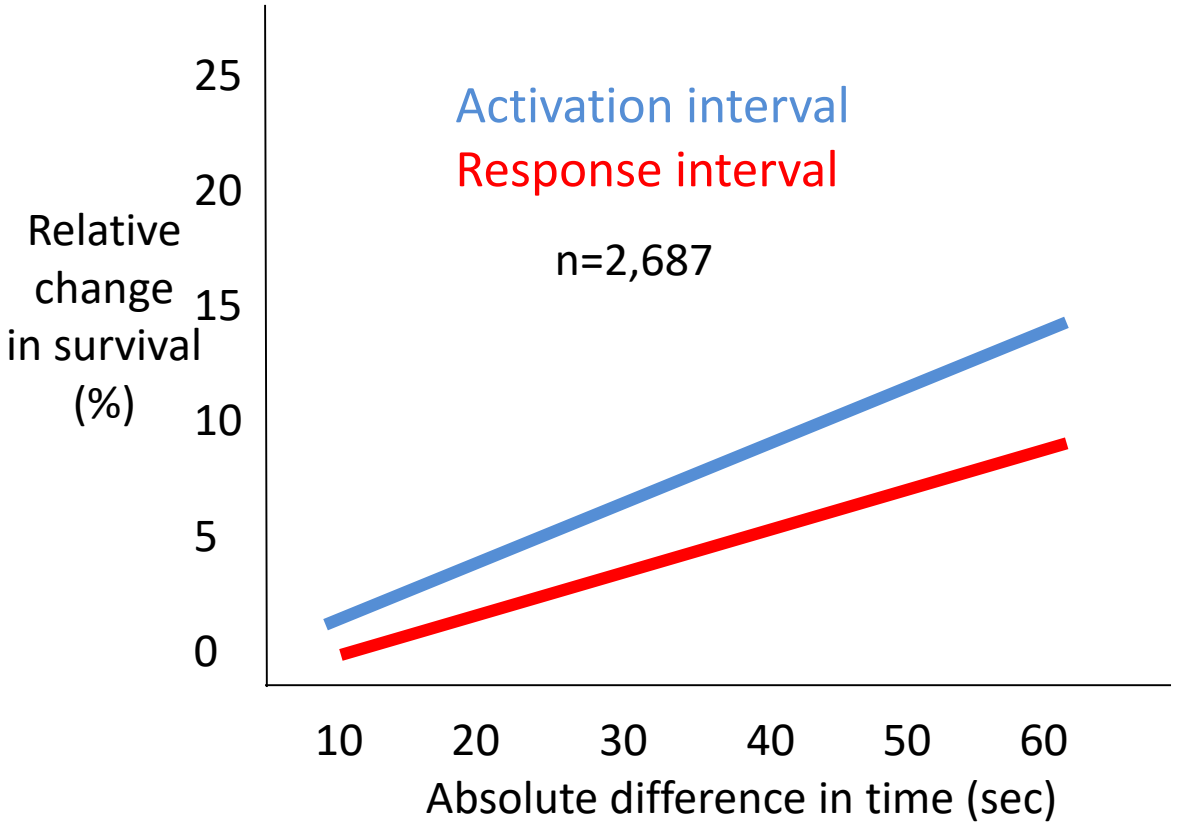
Resuscitation 2016

WARWICK CLINICAL TRIALS UNIT

911

Dispatch

Arrival



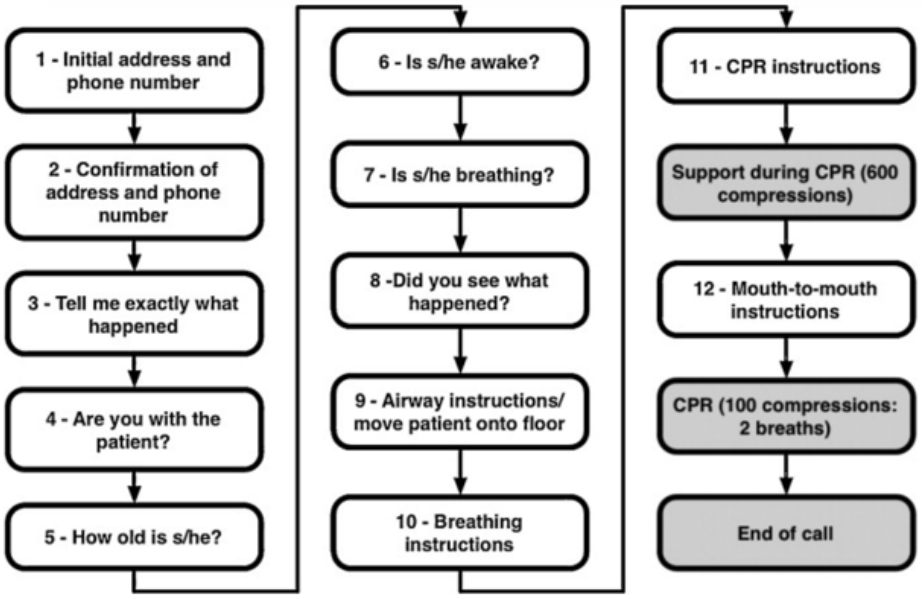
Clinical paper

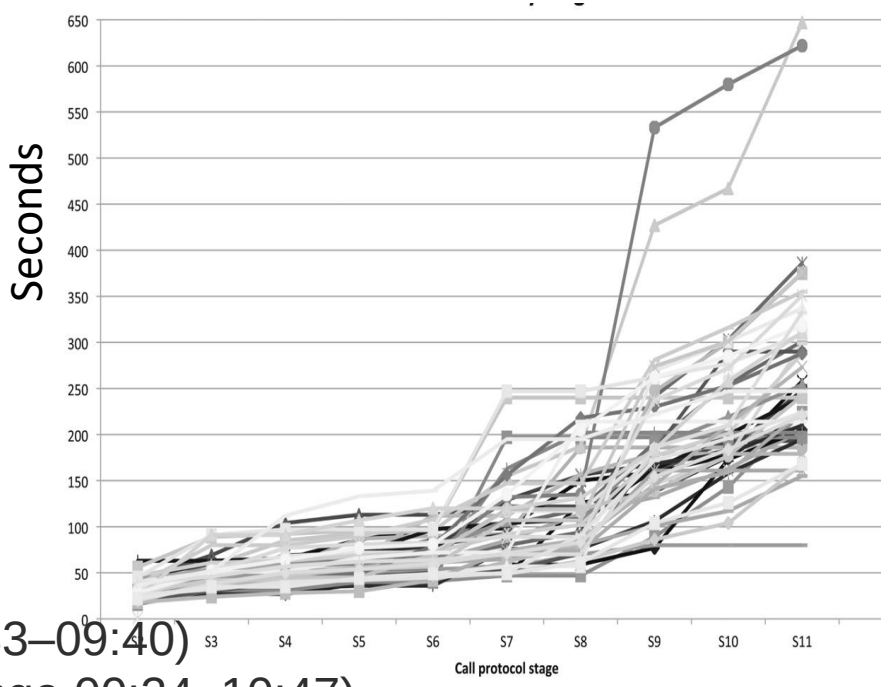
Dispatch-assisted CPR: Where are the hold-ups during calls to emergency dispatchers? A preliminary analysis of caller–dispatcher interactions during out-of-hospital cardiac arrest using a novel call transcription technique☆

Resuscitation 2014

Gareth R. Clegg[a,b], Richard M. Lyon[a,c,*], Scott James[a], Holly P. Branigan[d], Ellen G. Bard[e], Gerry J. Egan[f]

WARWICK CLINICAL TRIALS UNIT





Time to CA recognition 03:39 s (range 00:33–09:40)
Time to first chest compression 04:45 s (range 00:24–10:47)

Cardiac arrest recognition

WARWICK
CLINICAL TRIALS UNIT

- Unresponsive
- Not breathing normally
- Seizures

- Train bystanders and dispatchers to recognise agonal breathing

Perkins Circulation 2015

ORIGINAL ARTICLE

Ambulance telephone triage using 'NHS Pathways' to identify adult cardiac arrest

Charles D Deakin,[1,2] Simon England,[2] Debbie Diffey[2]

Heart 2017

Unconscious, fitting, choking

Normal breathing

CPR instructions

ORIGINAL ARTICLE

Ambulance telephone triage using 'NHS Pathways' to identify adult cardiac arrest

Charles D Deakin,[1,2] Simon England,[2] Debbie Diffey[2]

Heart 2017

- Sensitivity 0.759 (95% CI 0.74 to 0.77)
- Specificity 0.986 (95% CI 0.99 to 0.99)

Category	%
Unconscious	22.44
Breathing/respiratory	19.79
Chest pain	10.23
Concern for welfare	8.23
Other medical	4.52
Neurological	4.12
Trauma	3.85
Cold and clammy	2.52
Death/dying	1.46

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CLINICAL TRIALS UNIT

YOU CAN'T IMPROVE WHAT YOU DON'T MEASURE.

Original Investigation

Implementation of a Regional Telephone Cardiopulmonary Resuscitation Program and Outcomes After Out-of-Hospital Cardiac Arrest

Bentley J. Bobrow, MD; Daniel W. Spaite, MD; Tyler F. Vadeboncoeur, MD; Chengcheng Hu, PhD; Terry Mullins, MBA; Wayne Tormala, MSW; Christian Dameff, MD; John Gallagher, MD; Gary Smith, MD; Micah Panczyk, MS

- Before after study
- Dispatcher bundle
  - Dispatcher training
    - Simplified cardiac arrest recognition
    - Emphasis on time to T-CPR
- Quality improvement (system and individual)

Quality improvement metrics

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CLINICAL TRIALS UNIT

(1) % recognised need for T-CPR

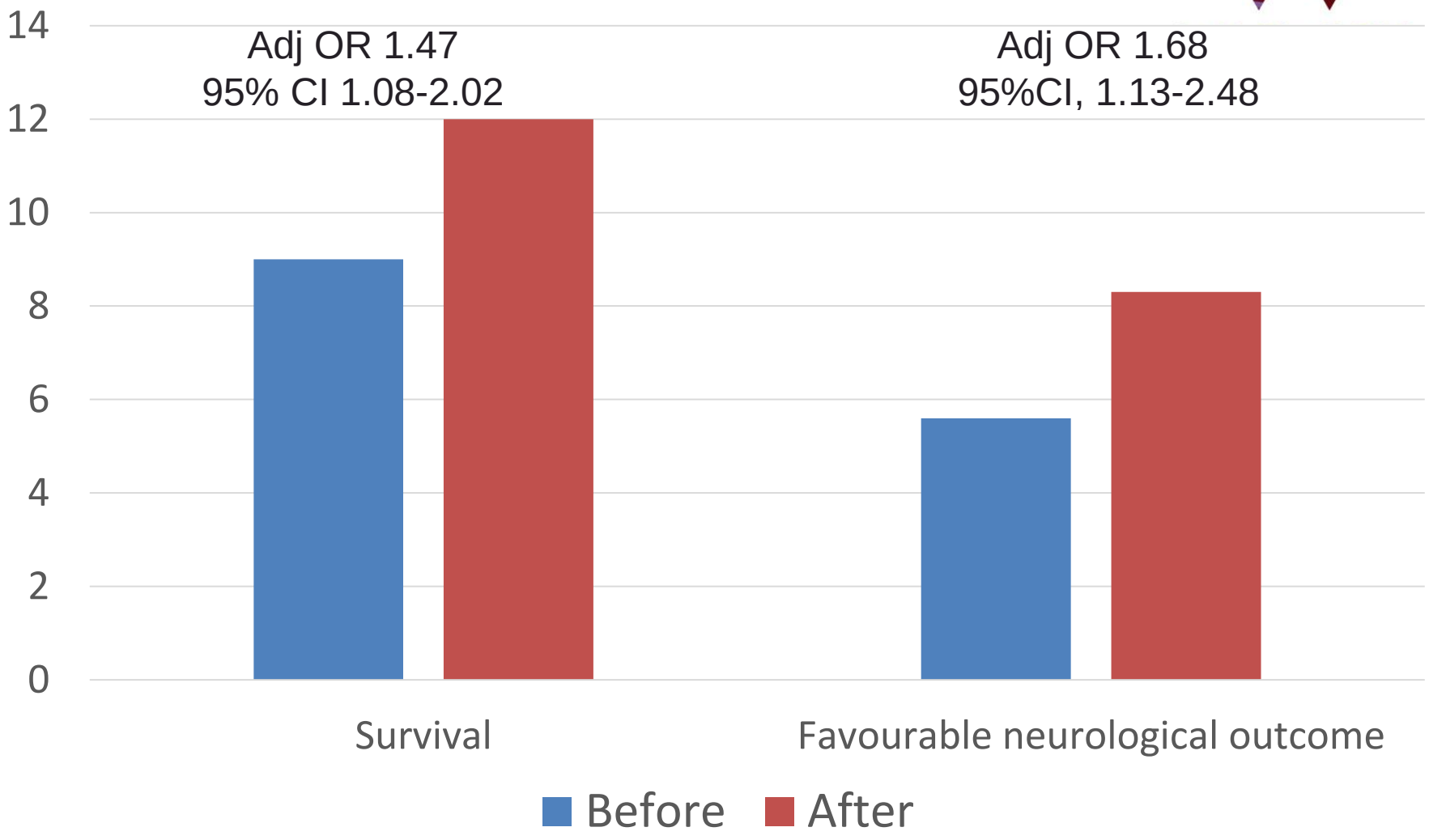
(2) % T-CPR instructions

(3) % bystander started CPR

(4) Time to recognition of CA

(5) Time from call to T-CPR instructions

(6) Time from call to first compression



10% Increase T-CPR; Shorter time to T-CPR (42s)

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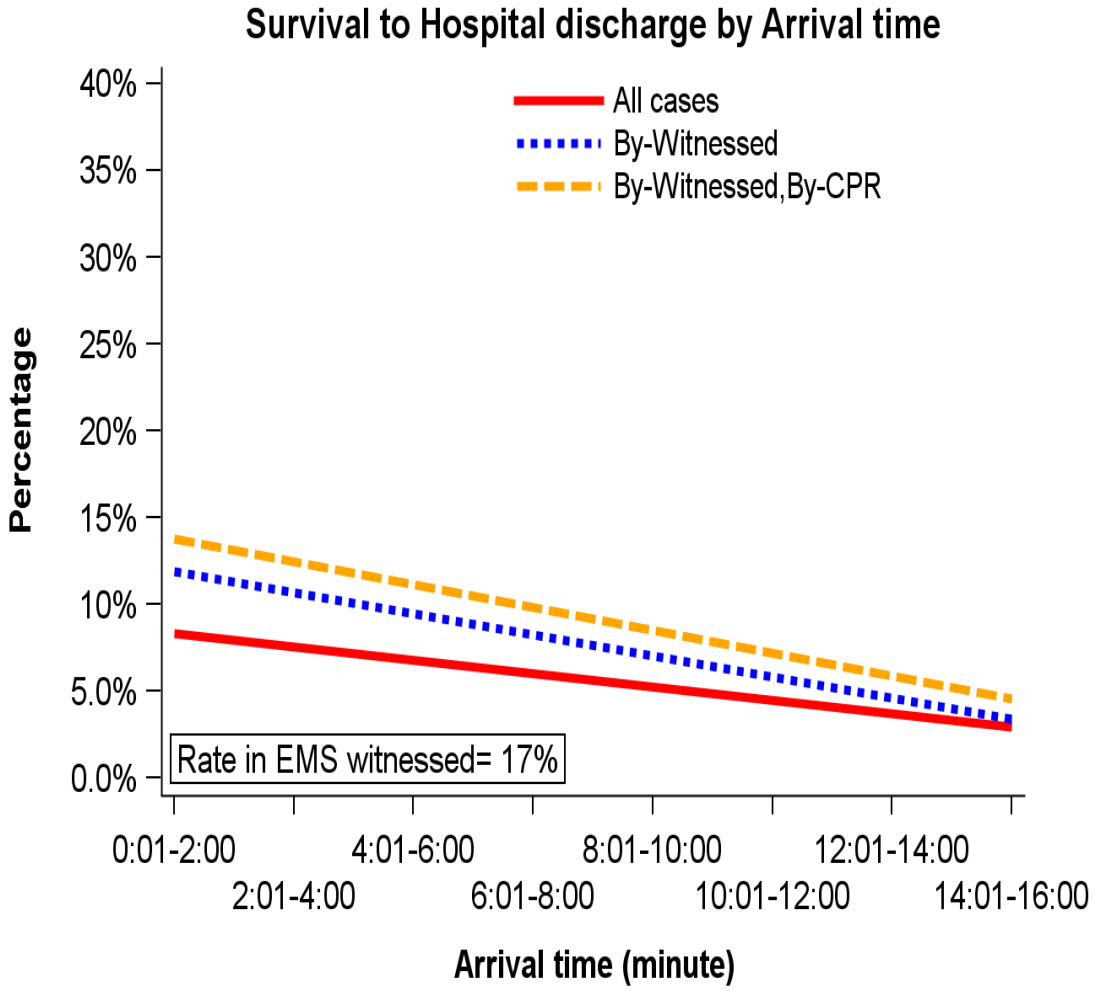
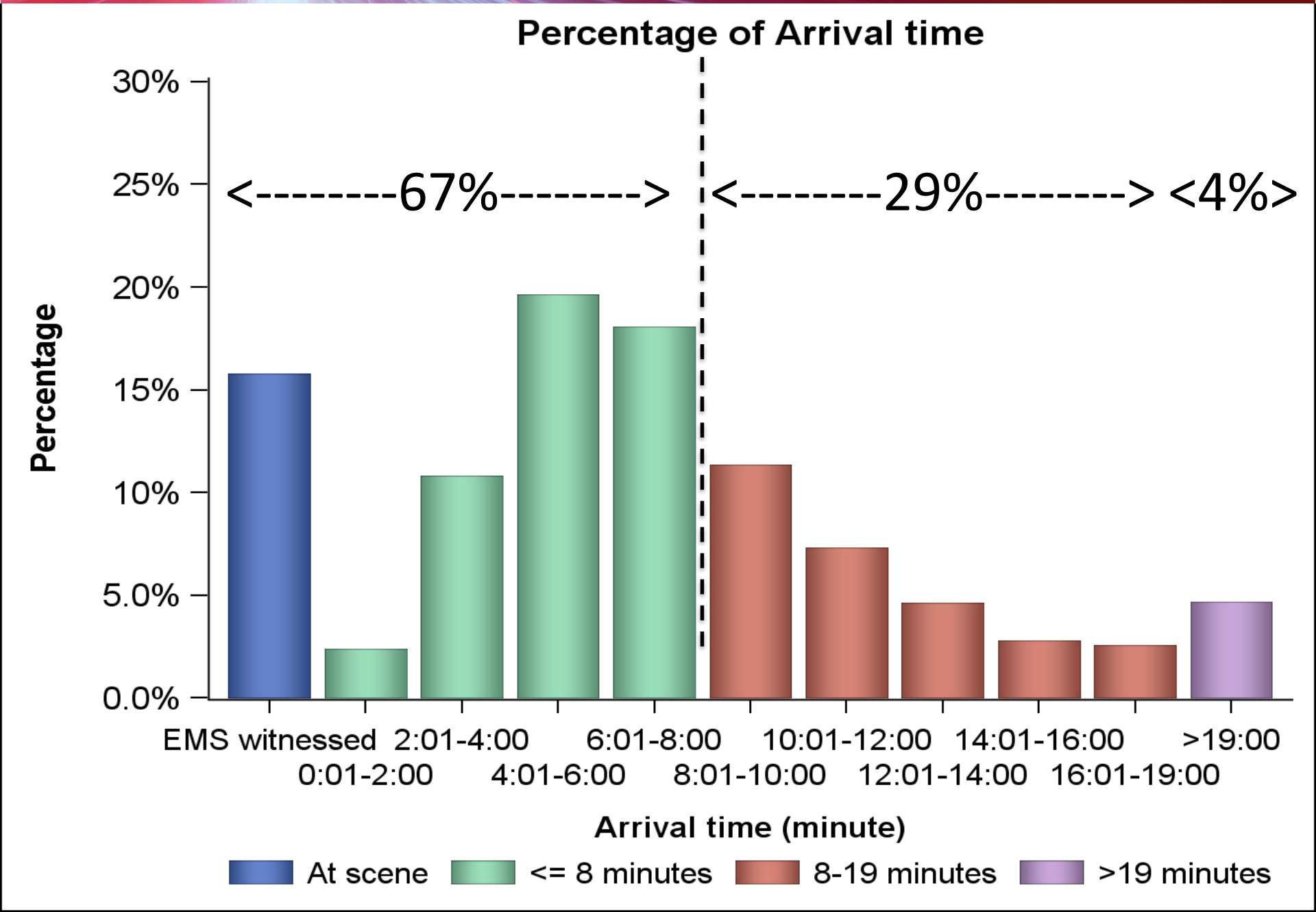
CLINICAL TRIALS UNIT




Percentage of Arrival time
<-------67%-------> <-------29%-------> <4%>
30%
25%
20%
15%
10%
5.0%
0.0%
Percentage
EMS witnessed
0:01-2:00
2:01-4:00
4:01-6:00
6:01-8:00
8:01-10:00
10:01-12:00
12:01-14:00
14:01-16:00
16:01-19:00
>19:00
Arrival time (minute)
At scene
<= 8 minutes
8-19 minutes
>19 minutes

WARWICK
CLINICAL TRIALS UNIT

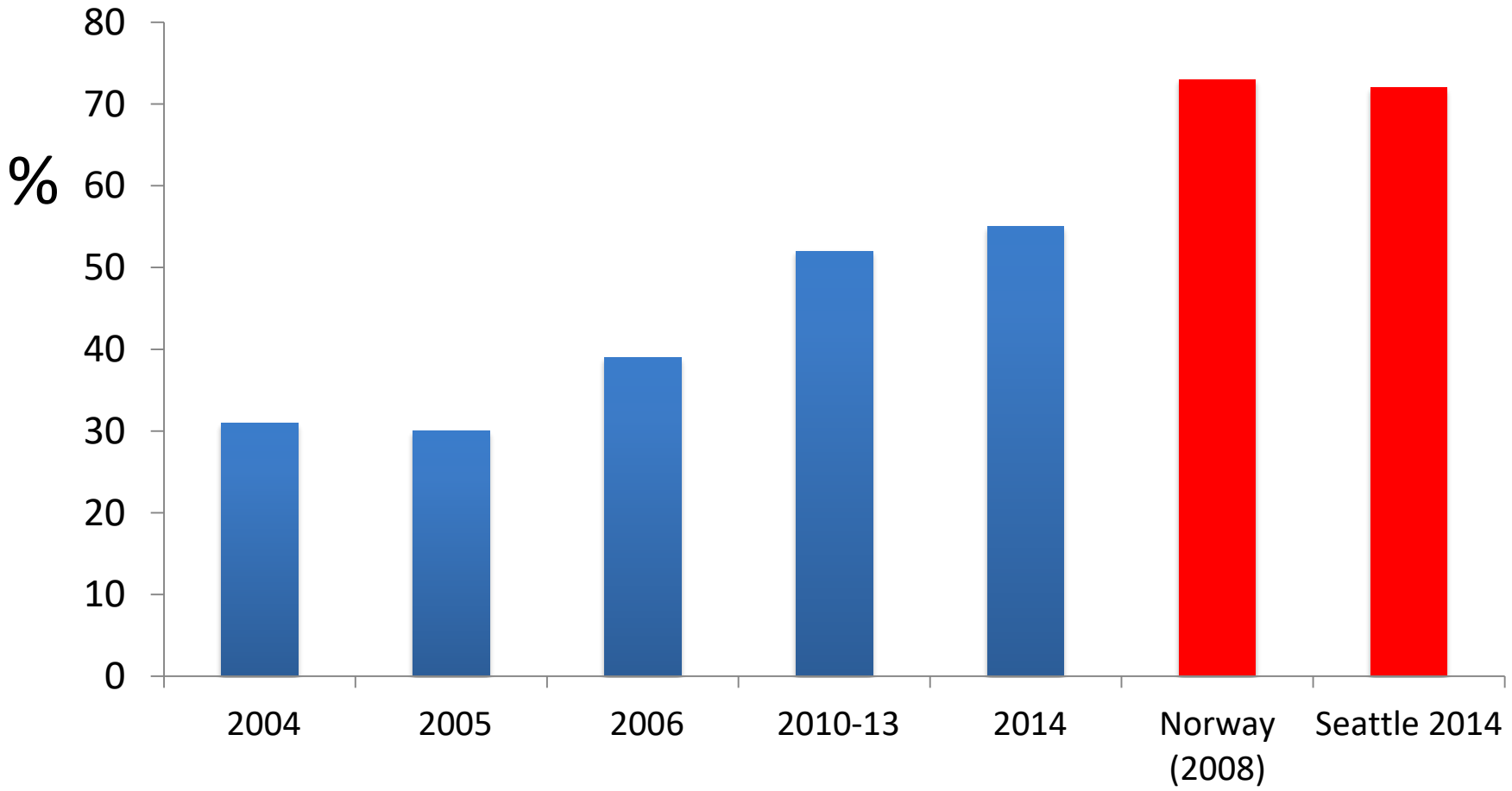
- Increases chances resuscitation attempted by EMS OR 27.8 (95% CI 18.52-41.67)

Rajagopal Resuscitation 2016

- Increases survival where CPR is attempted by EMS OR 2.44 (95% CI, 1.69 to 3.19)

Sasson Circ Cardiovasc Qual Outcomes 2010

Bystander CPR



* Norway, cardiac cause arrests

All school children are taught CPR and how to use an AED

Government blocks first aid Bill that could save thousands of lives

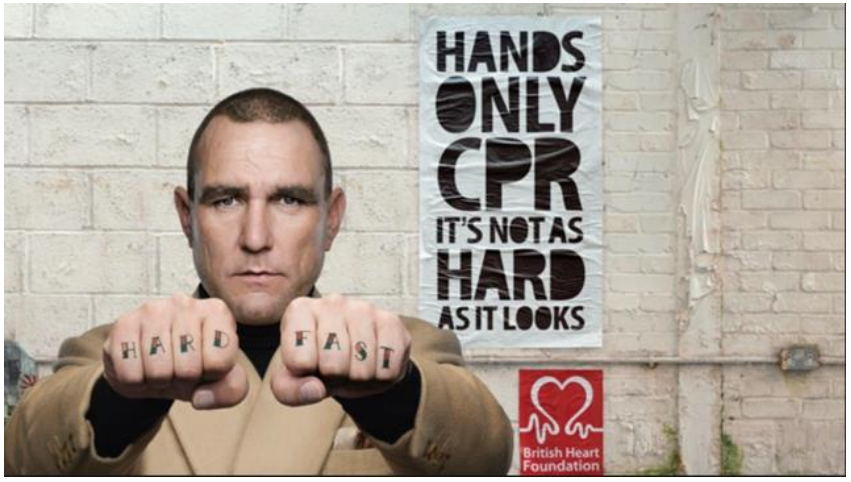
Tweet Recommend 808 G+1 2

20 November 2015

The British Red Cross and two more major UK charities have today declared their disappointment at the Government's failure to back a Private Members' Bill, despite mass public support. The Bill would have ensured all young people are given the opportunity to learn first aid in secondary schools.

Mrs Sheryll Murray (MP South East Cornwall) (Con): If somebody has a pulse that cannot be detected, or if somebody is breathing very shallowly, someone who comes along and starts to administer CPR could do damage to their health.

Everyone who is able to should learn CPR



Resuscitation Council (UK)

BritishRedCross

St John Ambulance

British Heart Foundation

Yorkshire Ambulance Service NHS
NHS Trust

2016: 150,000 children trained

1 World Record Broken!

Original Investigation

Association of Bystander and First-Responder Intervention With Survival After Out-of-Hospital Cardiac Arrest in North Carolina, 2010-2013

JAMA 2015

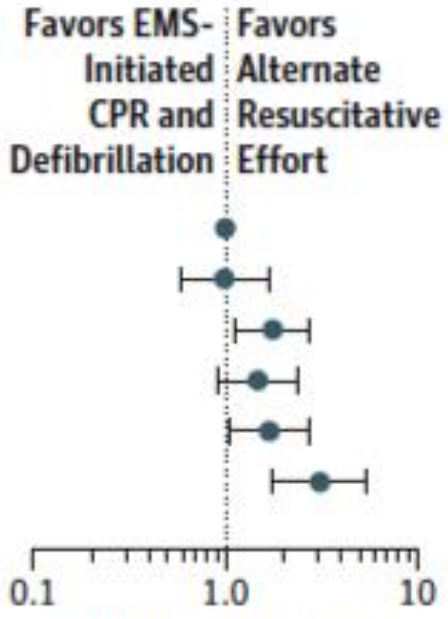
Carolina Malta Hansen, MD; Kristian Kragholm, MD; David A. Pearson, MD; Clark Tyson, MS, NREMT-P; Lisa Monk, MSN, RN, CPHQ; Brent Myers, MD; Darrell Nelson, MD; Matthew E. Dupre, PhD; Emil L. Fosbøl, MD, PhD; James G. Jollis, MD; Benjamin Strauss, MS; Monique L. Anderson, MD; Bryan McNally, MD, MPH; Christopher B. Granger, MD

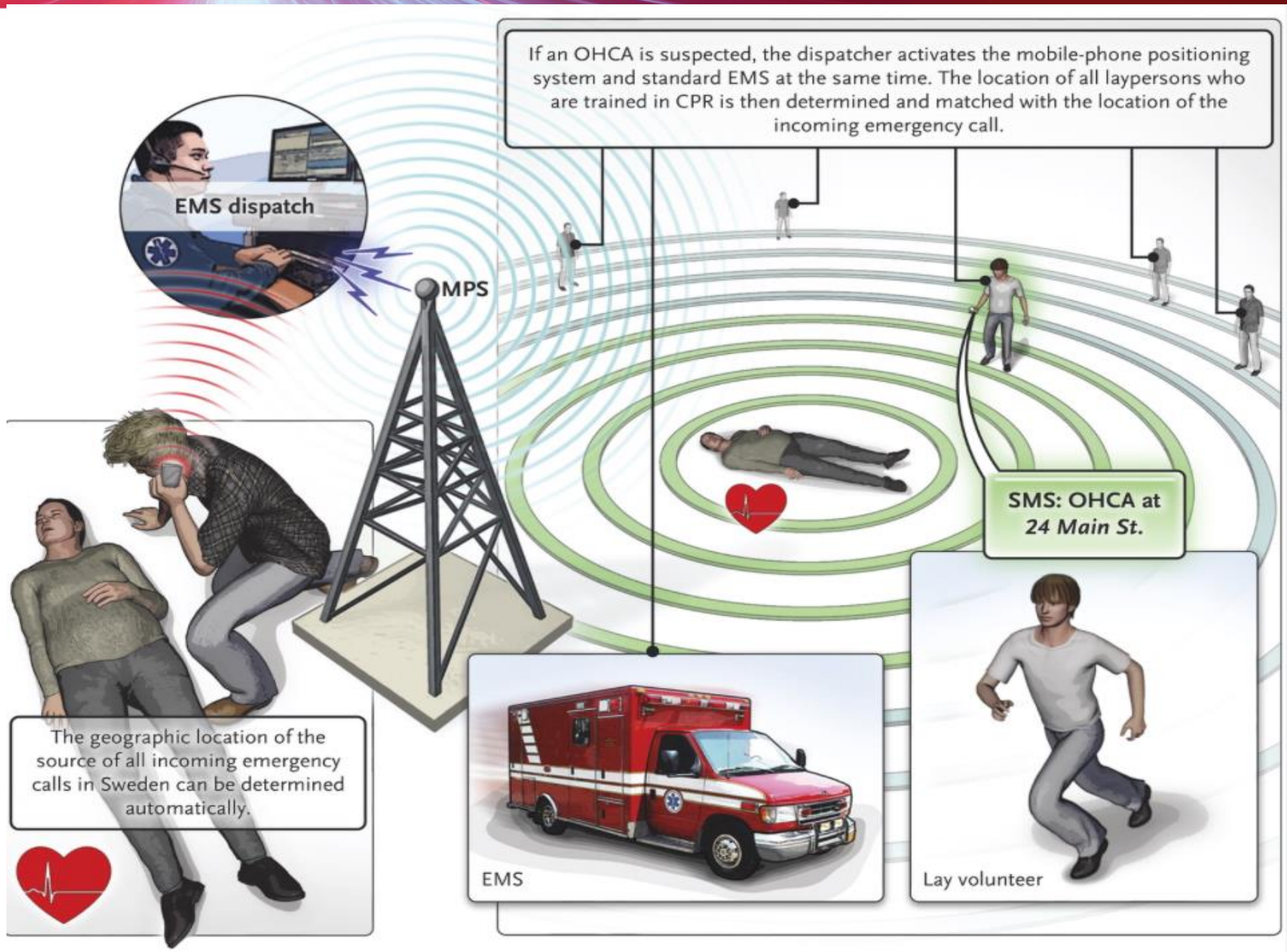
- Community intervention
  - CPR in schools
  - Mass CPR training
- Dispatcher
- First responders
- Legislation – AED, CPR in schools
- Post resuscitation care

- Survival to discharge 8.4% to 10.5%
- Favourable neurological outcome 9% to 9.5%

B Survival to discharge

Resuscitation				
Initiated CPR	Defibrillation	No. of Patients	No. of Events	Adjusted OR (95% CI)[a]
EMS	EMS	198	30	1 [Reference]
First responder	EMS	212	33	0.99 (0.58-1.70)
First responder	First responder	432	109	1.77 (1.13-2.77)
Bystander	EMS	350	76	1.48 (0.92-2.36)
Bystander	First responder	343	83	1.70 (1.06-2.71)
Bystander	Bystander	113	38	3.12 (1.78-5.46)

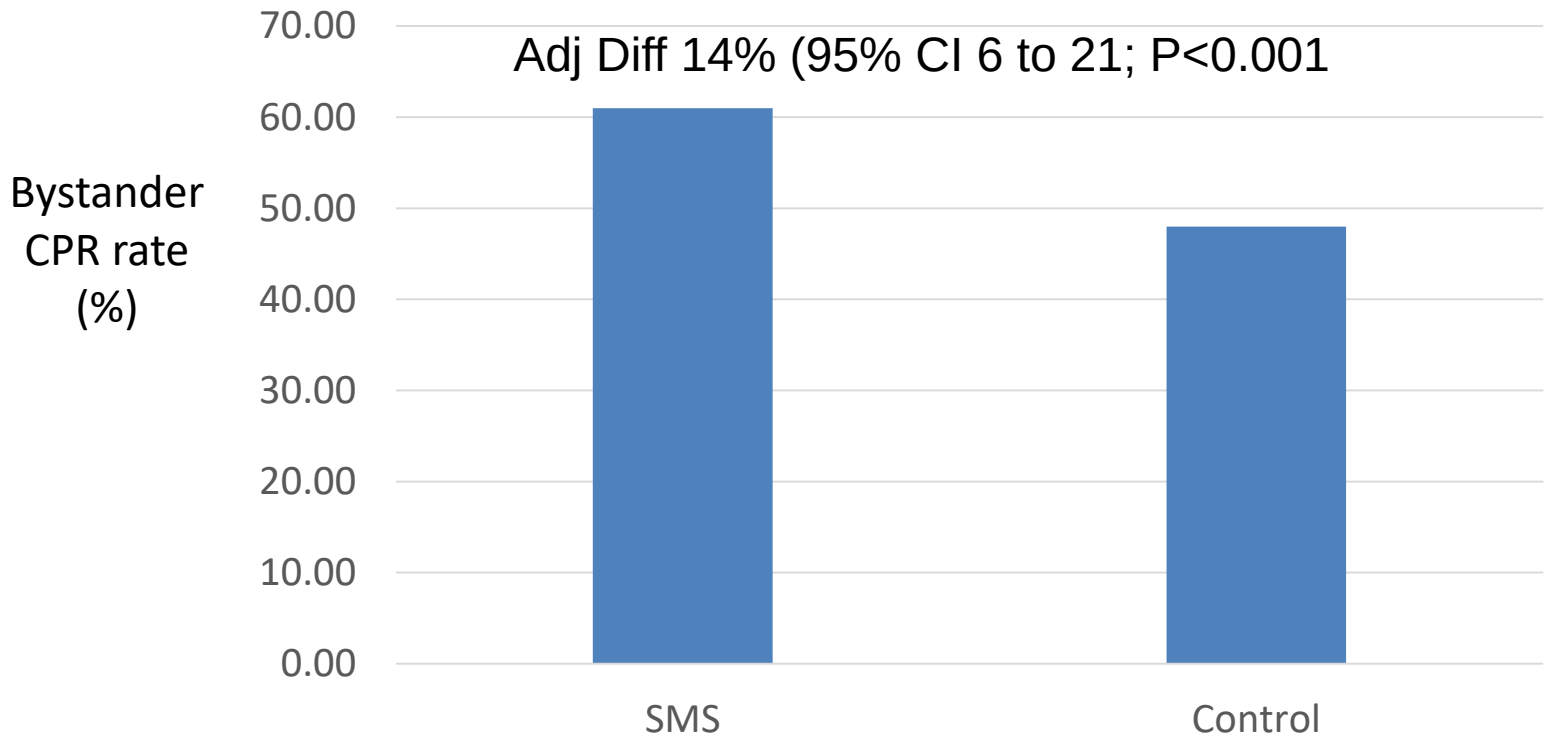



If an OHCA is suspected, the dispatcher activates the mobile-phone positioning system and standard EMS at the same time. The location of all laypersons who are trained in CPR is then determined and matched with the location of the incoming emergency call.
EMS dispatch
MPS
SMS: OHCA at 24 Main St.
The geographic location of the source of all incoming emergency calls in Sweden can be determined automatically.
EMS
Lay volunteer

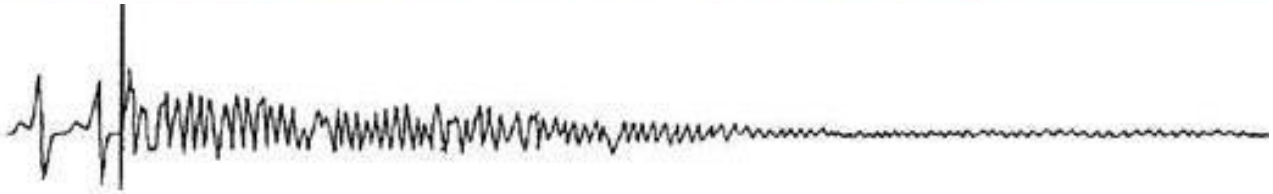
Mobile-Phone Dispatch of Laypersons for CPR in Out-of-Hospital Cardiac Arrest

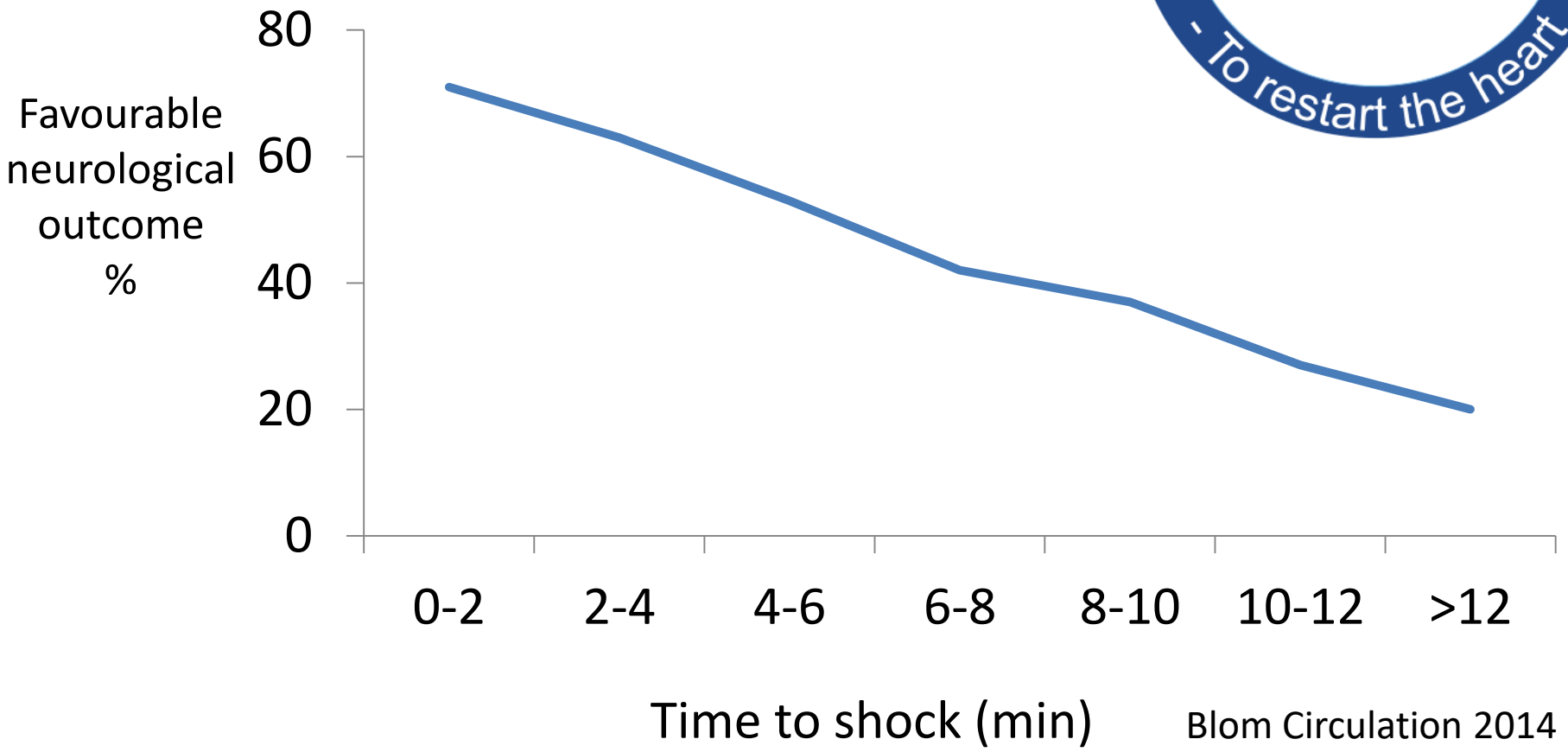
Mattias Ringh, M.D., Mårten Rosenqvist, M.D., Ph.D., Jacob Hollenberg, M.D., Ph.D., Martin Jonsson, B.Sc., David Fredman, R.N., Per Nordberg, M.D., Hans Järnbert-Pettersson, Ph.D., Ingela Hasselqvist-Ax, R.N., Gabriel Riva, M.D., and Leif Svensson, M.D., Ph.D.

WARWICK CLINICAL TRIALS UNIT

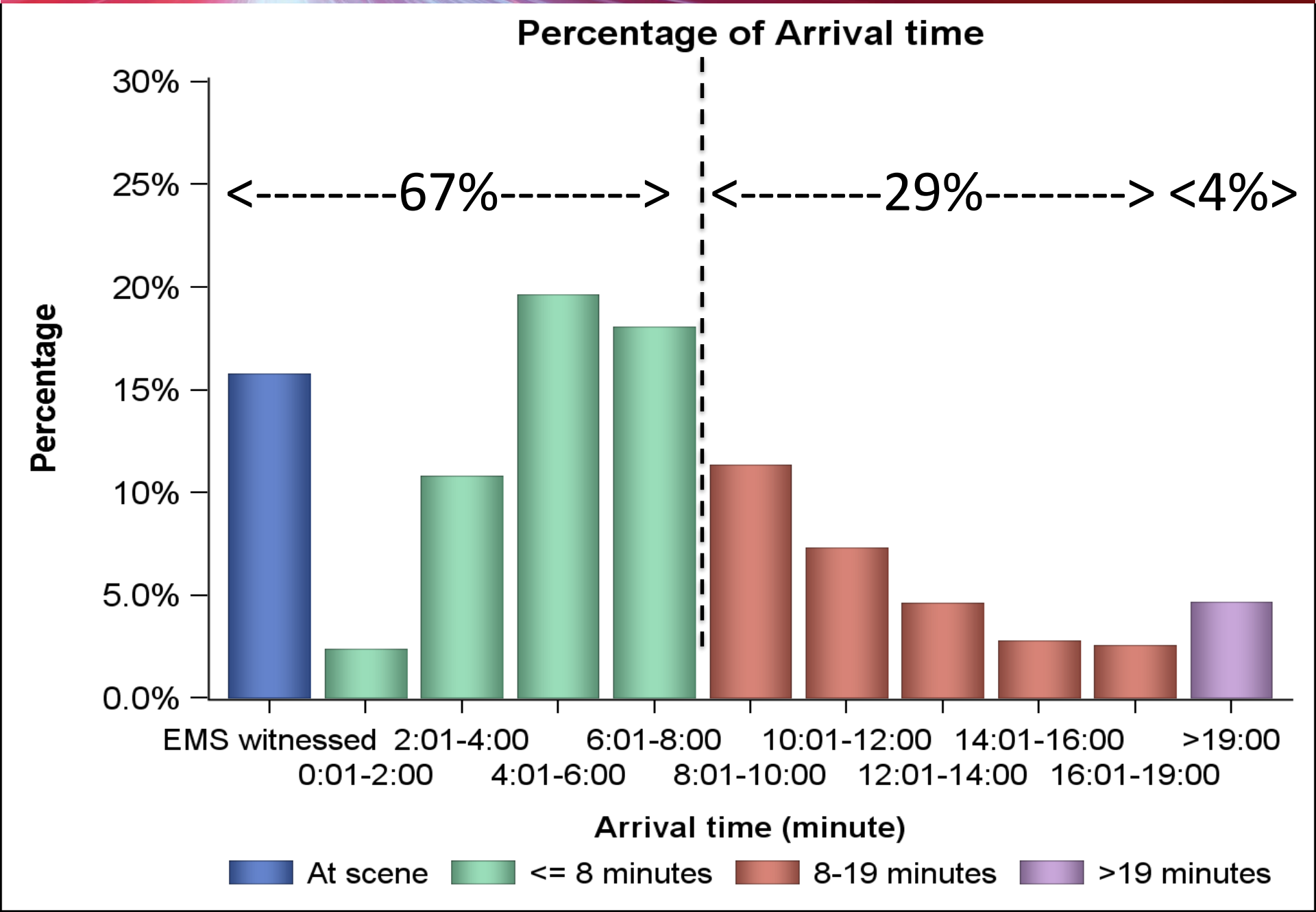


NEJM 2015



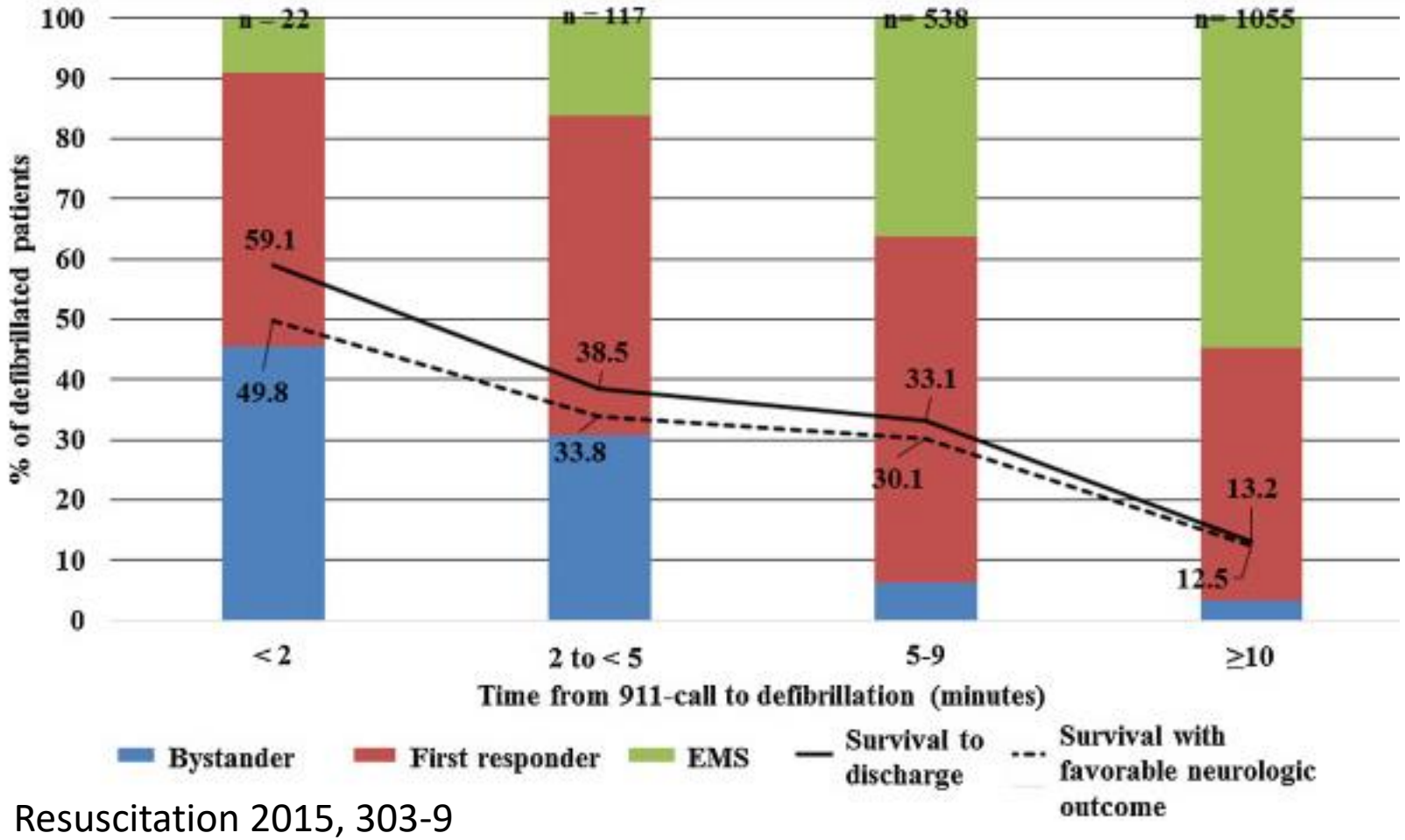


Blom Circulation 2014


Percentage of Arrival time
<-------67%-------> <-------29%-------> <4%>
30%
25%
20%
15%
10%
5.0%
0.0%
Percentage
EMS witnessed
0:01-2:00
2:01-4:00
4:01-6:00
6:01-8:00
8:01-10:00
10:01-12:00
12:01-14:00
14:01-16:00
16:01-19:00
>19:00
Arrival time (minute)
At scene
<= 8 minutes
8-19 minutes
>19 minutes

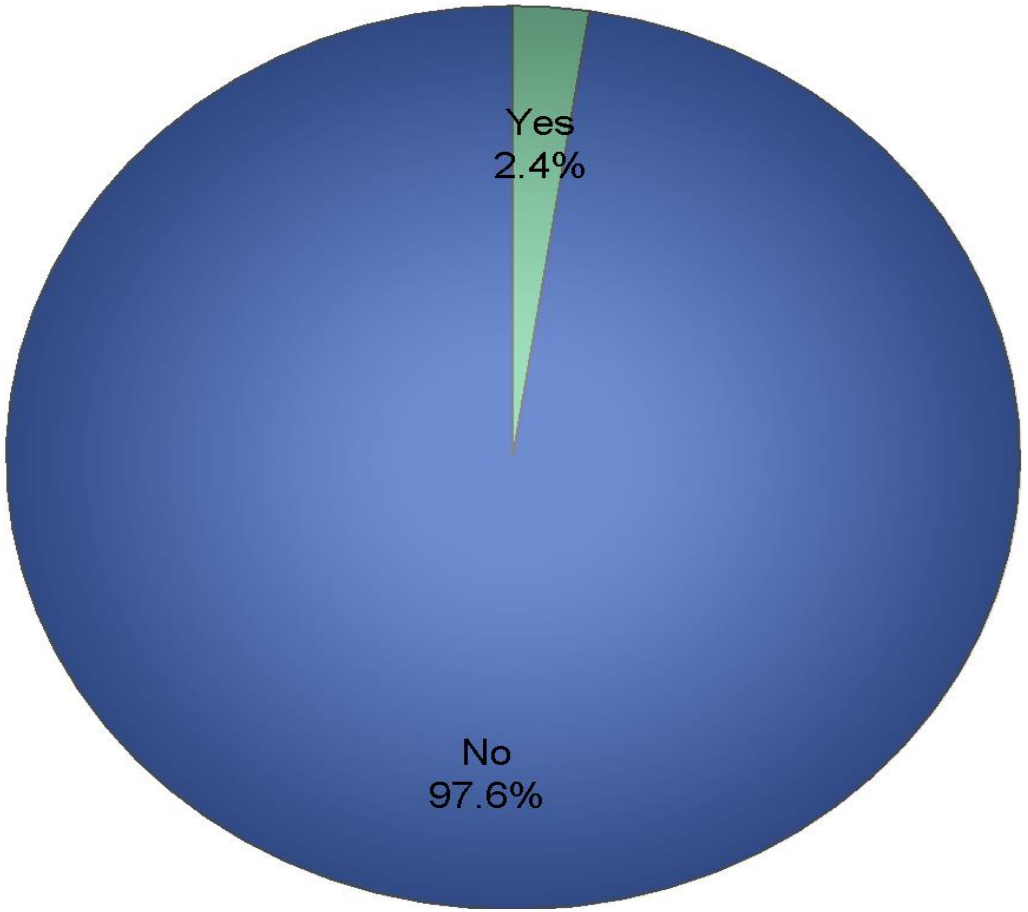
The role of bystanders, first responders, and emergency medical service providers in timely defibrillation and related outcomes after out-of-hospital cardiac arrest: Results from a statewide registry☆

Carolina Malta Hansen[a,*], Kristian Kragholm[a], Christopher B. Granger[a],

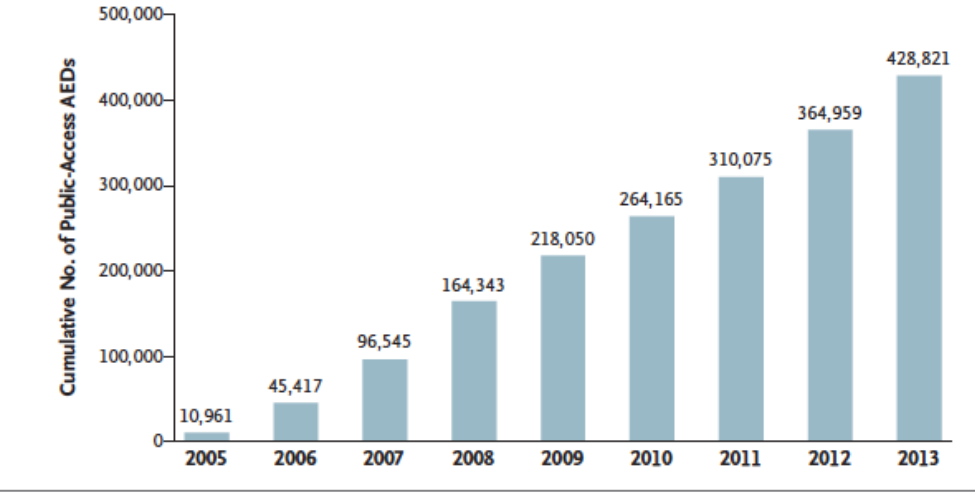


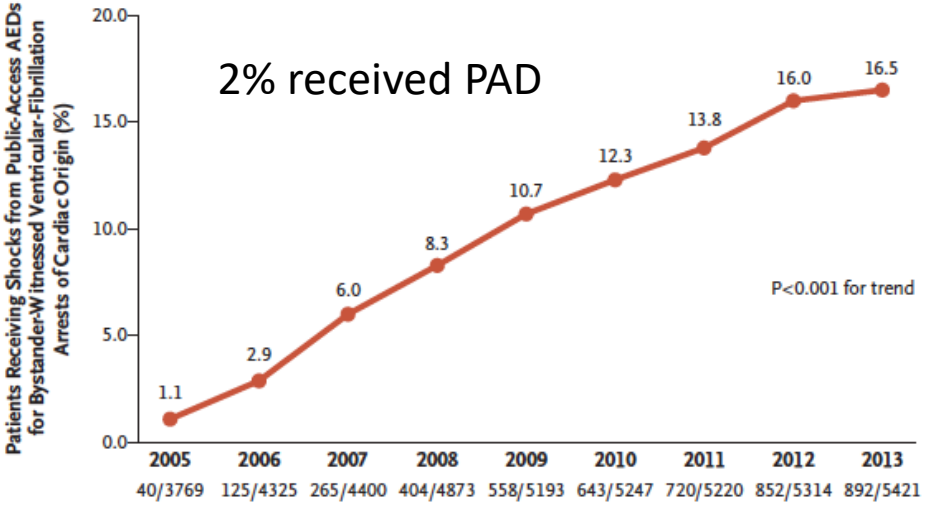
Resuscitation 2015, 303-9


Defibrillator

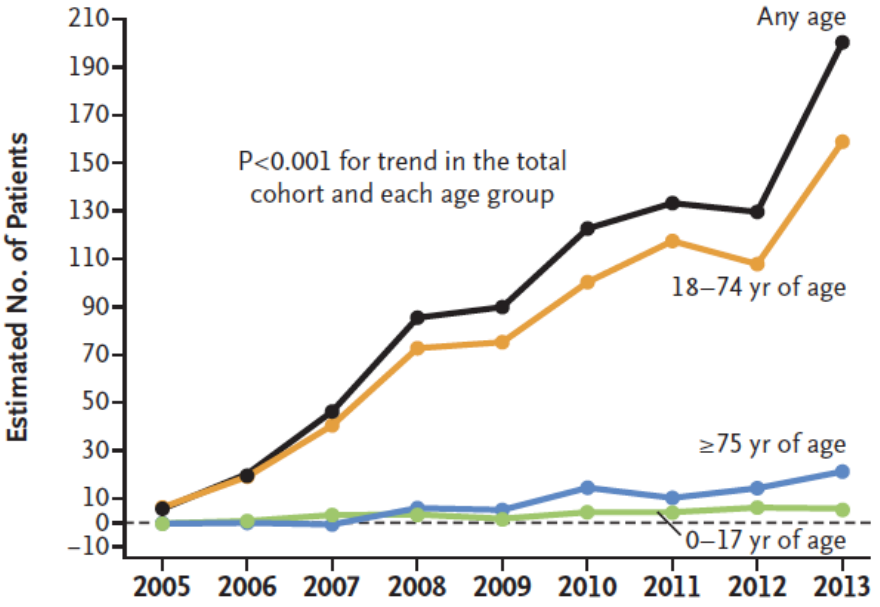

Yes
2.4%
No
97.6%

WARWICK
CLINICAL TRIALS UNIT

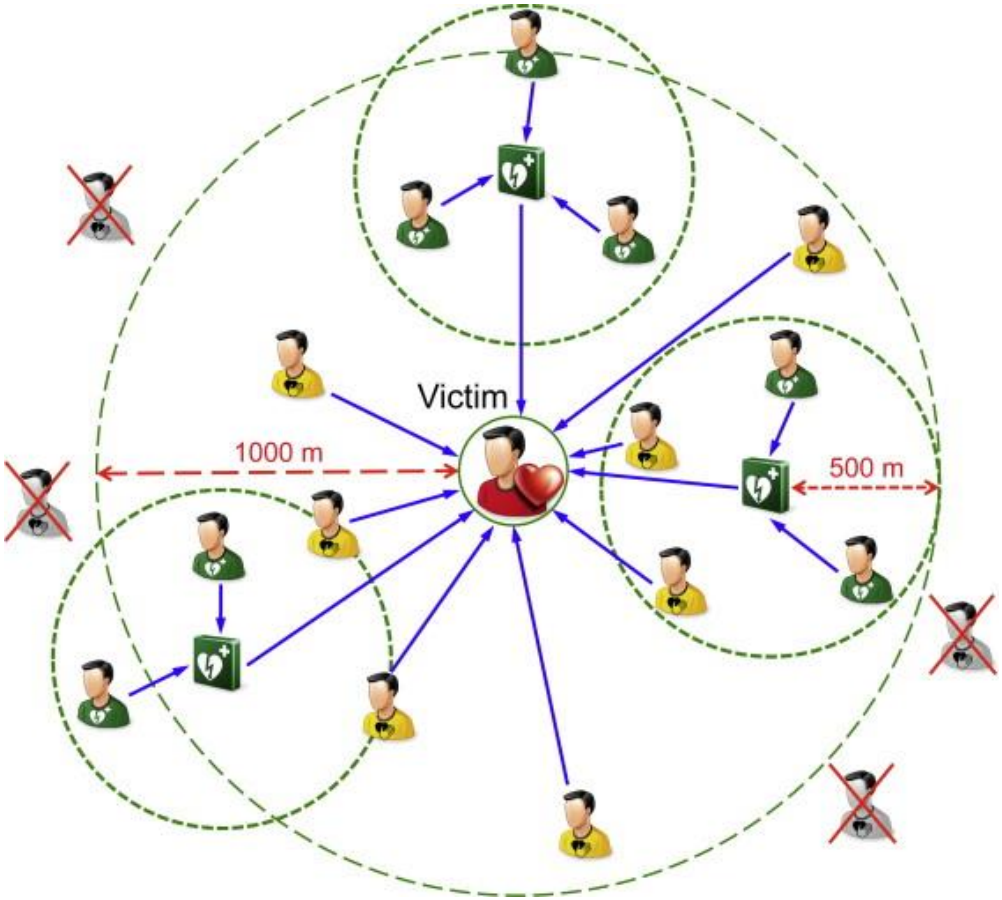




2% received PAD



NEJM 2015



Reduced time to first shock by 2 min 39 s compared to EMS

Zijlstra *et al* Resuscitation 2014

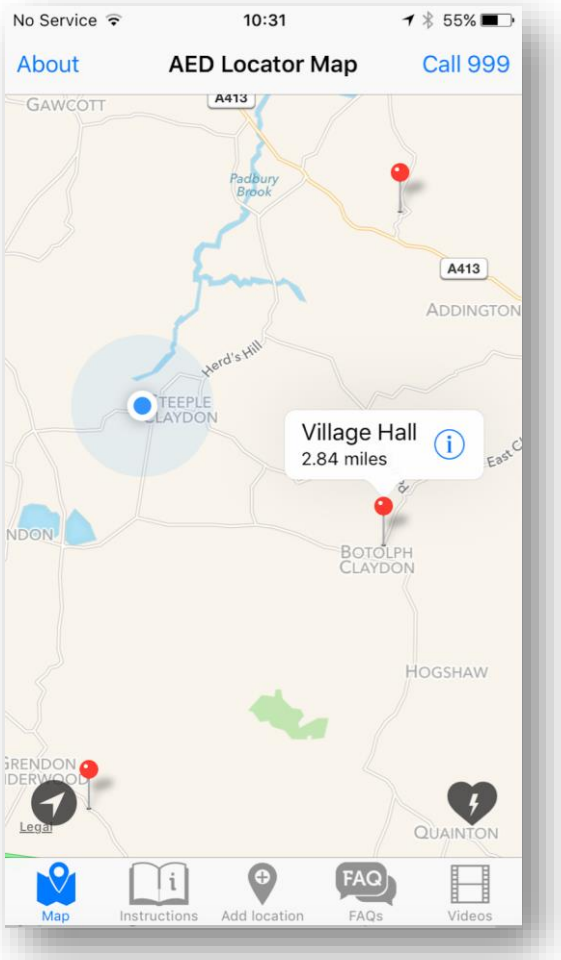
GoodSAM

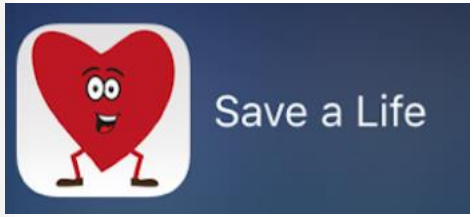
The World's Most Advanced Emergency Alerting platform

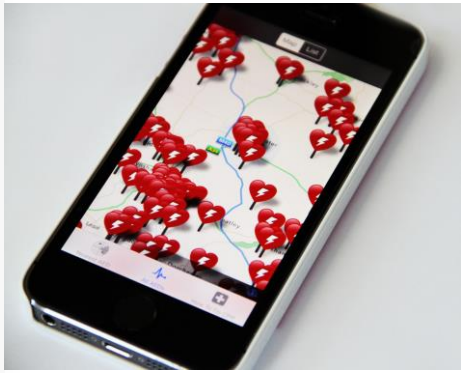
GoodSAM Pro

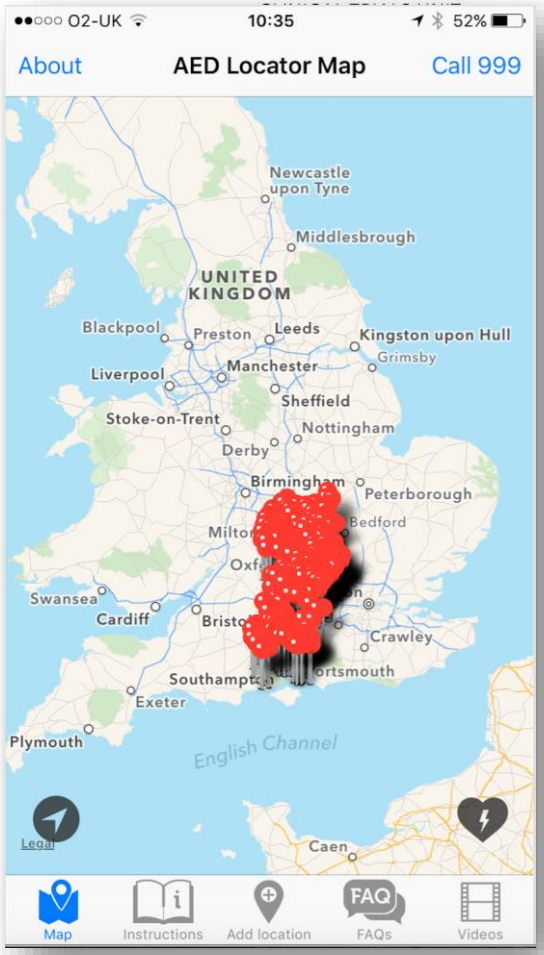
www.goodsamapp.org

AED locator

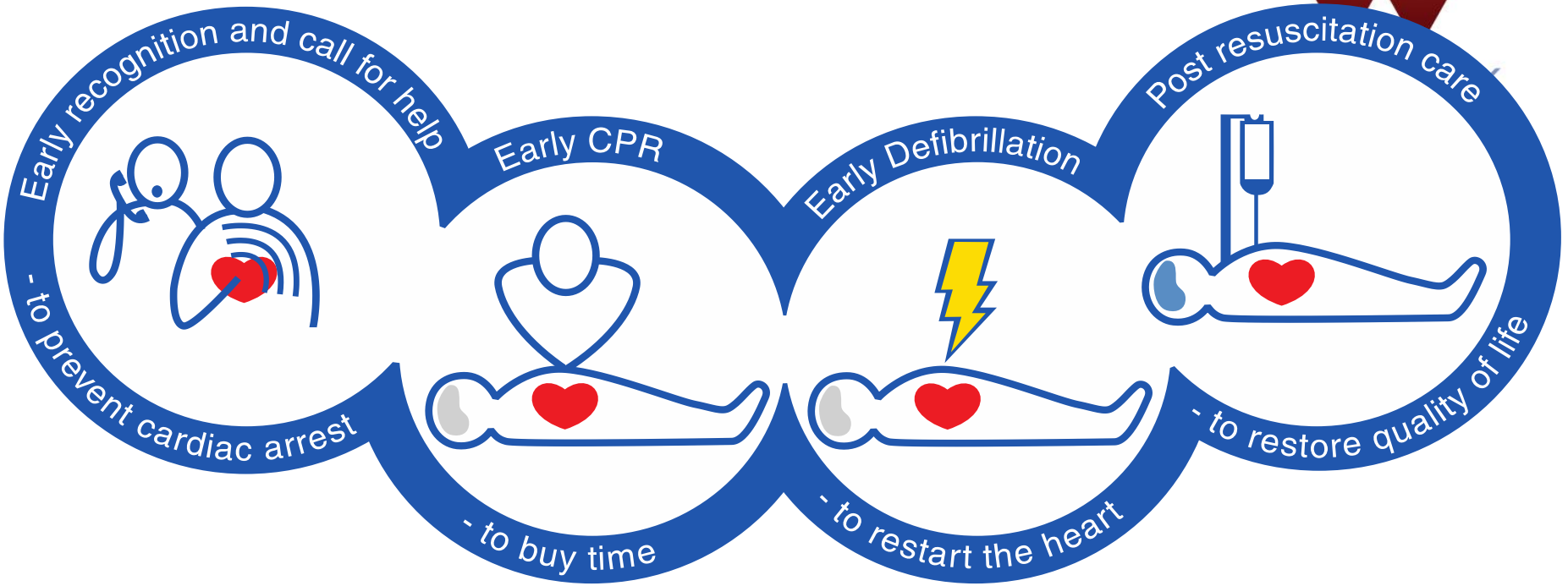






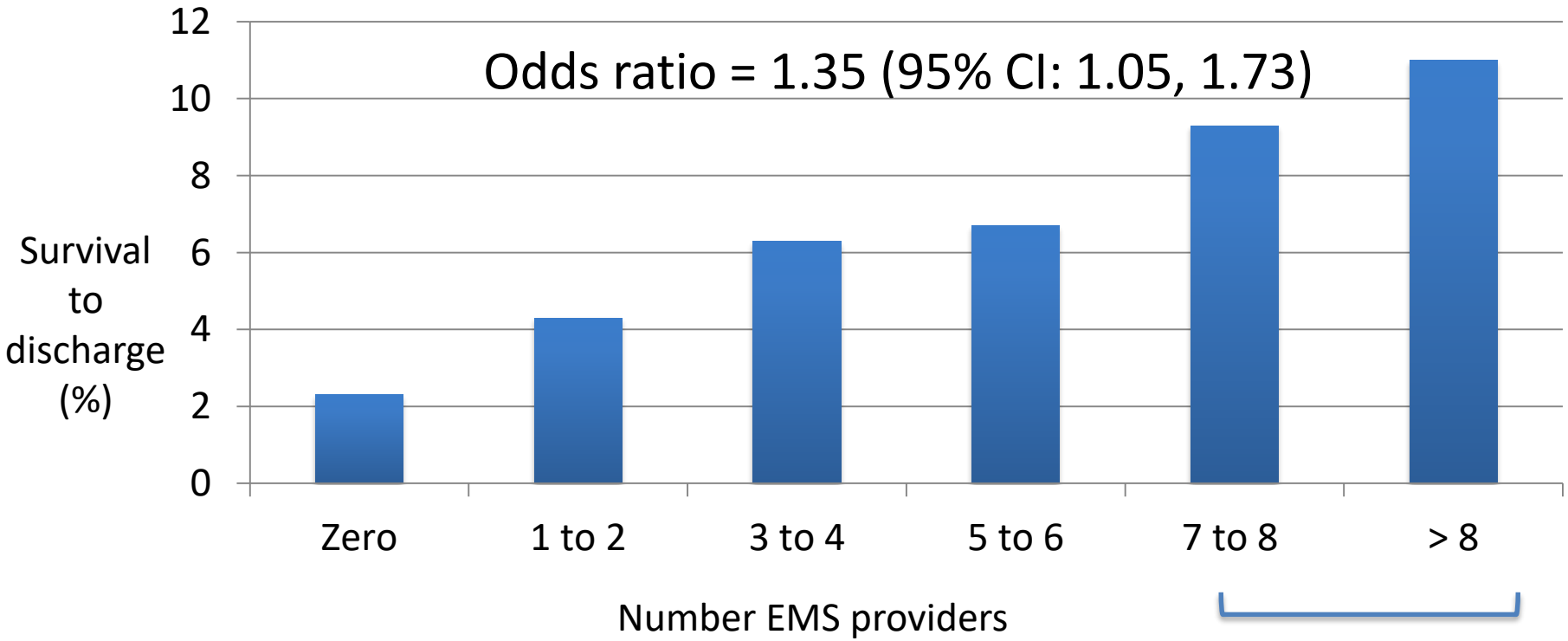


Contact: gillian.hodgetts@scas.nhs.uk


Early recognition and call for help
- to prevent cardiac arrest
Early CPR
- to buy time
Early Defibrillation
- to restart the heart
Post resuscitation care
- to restore quality of life

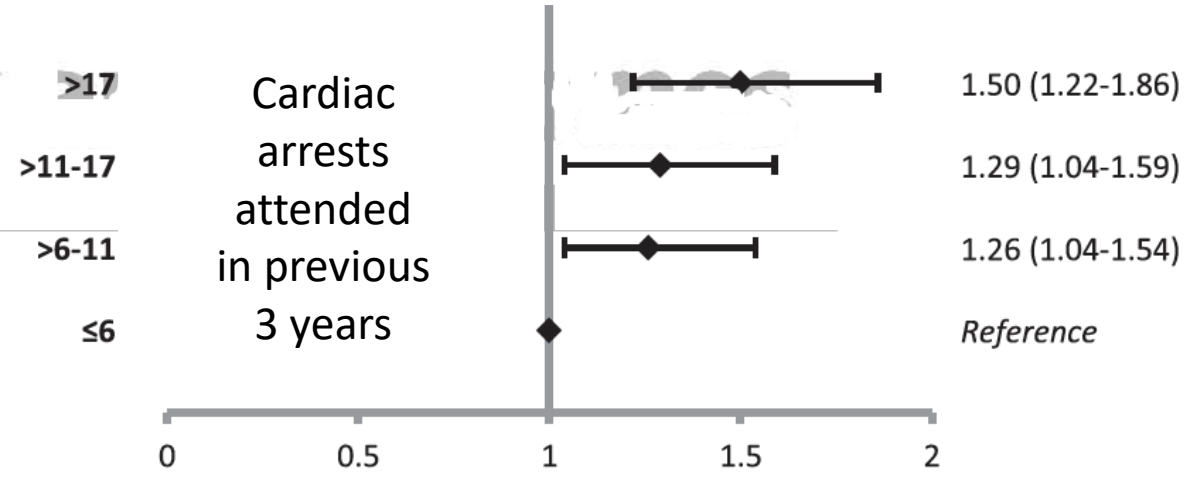
Volume versus outcome: More emergency medical services personnel on-scene and increased survival after out-of-hospital cardiac arrest☆

Sam A. Warren[a,b,*], David K. Prince[d,g], Ella Huszti[a,b], Tom D. Rea[b], Annette L. Fitzpatrick[c,e,f], Douglas L. Andrusiek[h], Steve Darling[i], Laurie J. Morrison[j], Gary M. Vilke[k], Graham Nichol[a,b,g], the ROC Investigators



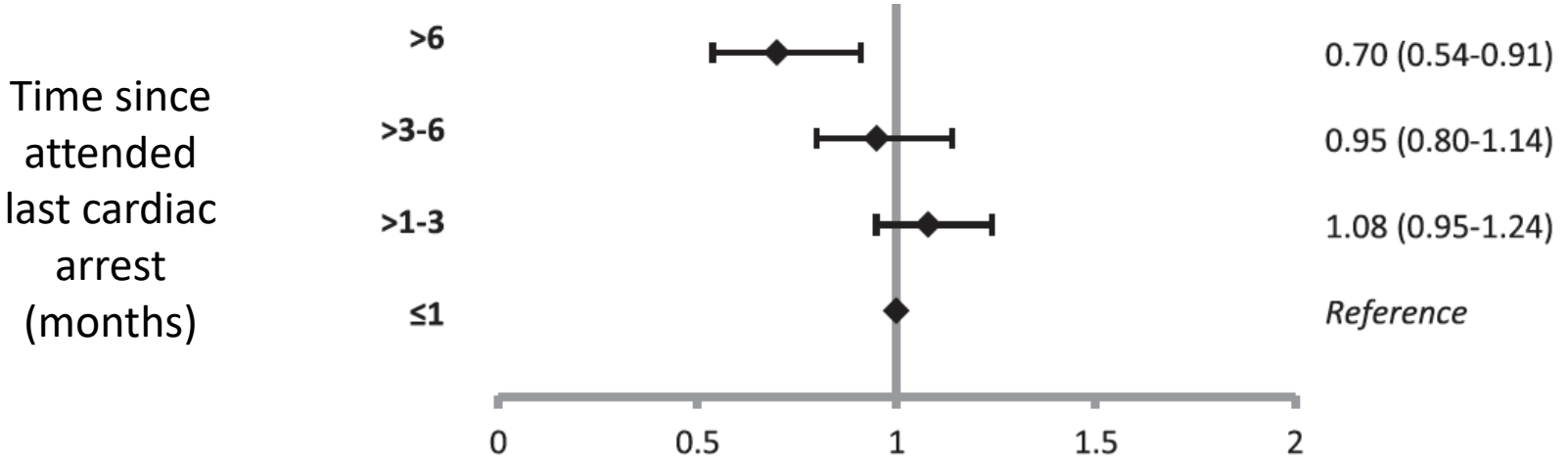
Resuscitation 94 (2015) 40–48

Skilled teams



Paramedic exposure to cardiac arrest influences survival

Dyson
Circ Cardiovasc Qual Outcomes. 2016



High quality CPR

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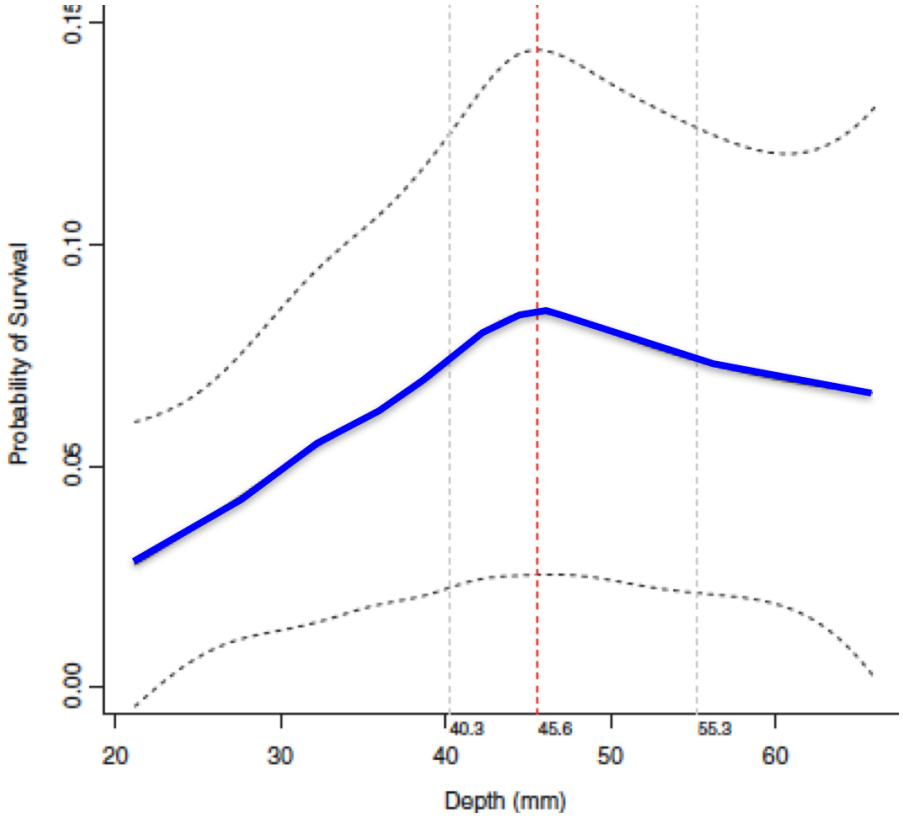
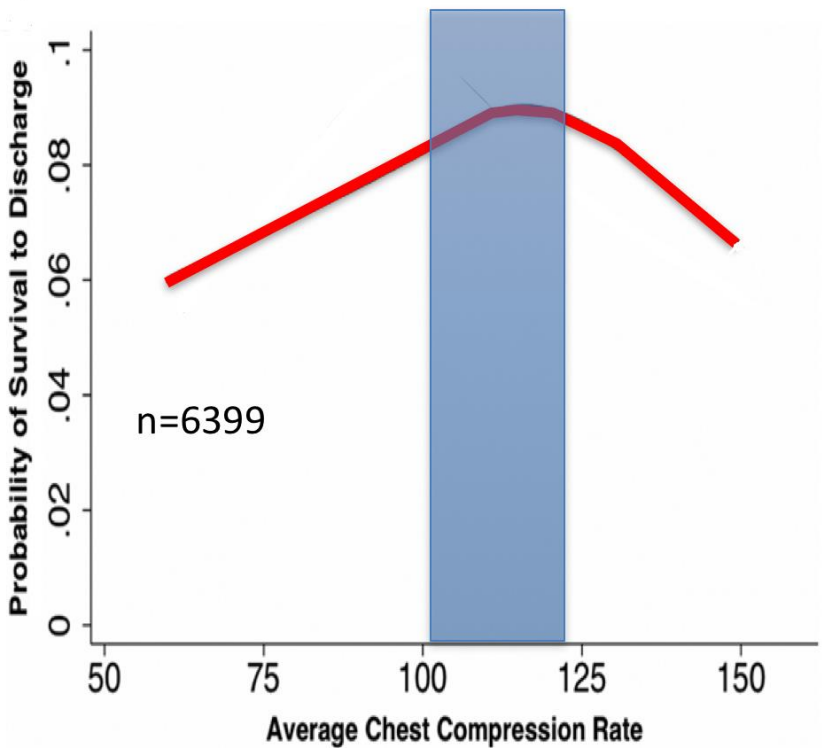
CLINICAL TRIALS UNIT

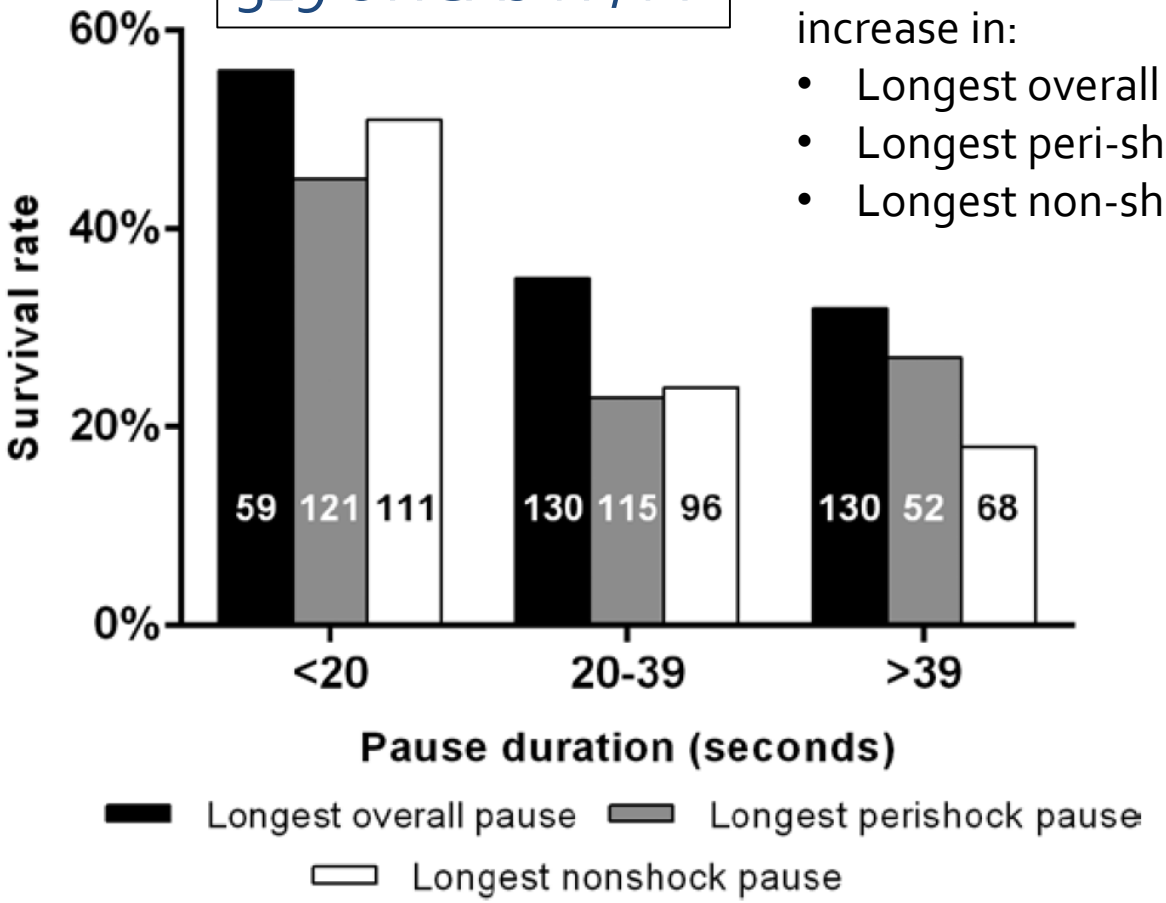




Avoid interruptions in compressions

WARWICK
CLINICAL TRIALS UNIT

319 OHCAs VF/VT



Lower odds ratio (OR) for survival per 5 second increase in:

- Longest overall pause OR 0.85 (0.77–0.93)
- Longest peri-shock OR 0.85 (0.77–0.93)
- Longest non-shock OR 0.83 (0.75–0.91)

Message:
Any pause is bad

Brouwer TF Circulation 2015

4 Person Pit Crew Formation

Drilled teams

Airway, Drug prep

#3

Focus on monitor

Defib, IV/IO Meds

#2

Others need to help #1:

1. Make sure Chest Compressor can see monitor!!!
2. Do not interrupt Chest Compressors- they need to focus on delivery of quality chest compressions.

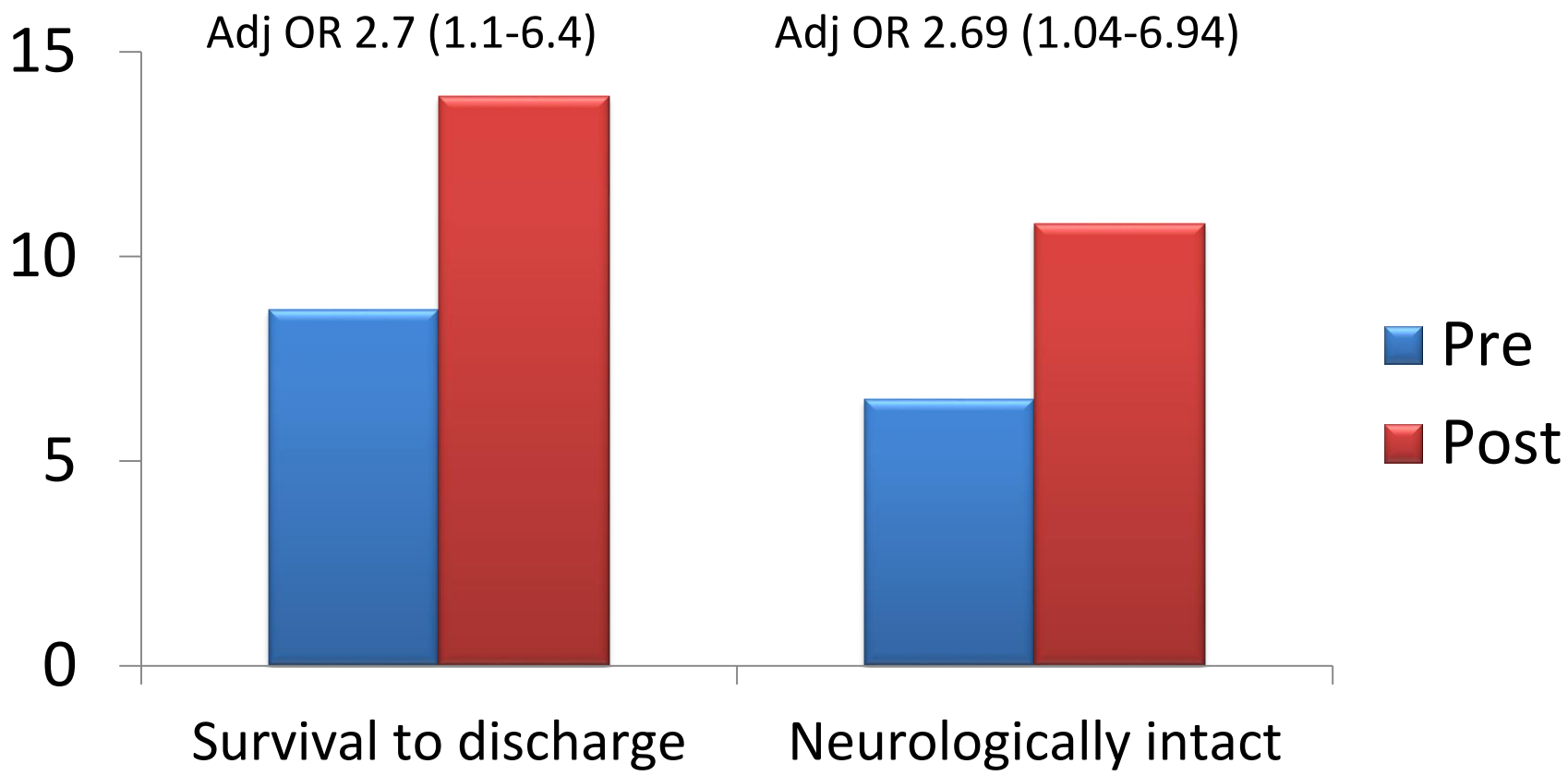
Chest Compressors (switch every 2 min)!!

Second compressor, IV Prep and watch monitor

B

Bobrow *et al* Ann Emerg Med 62(1), 2013, 47–56.e1

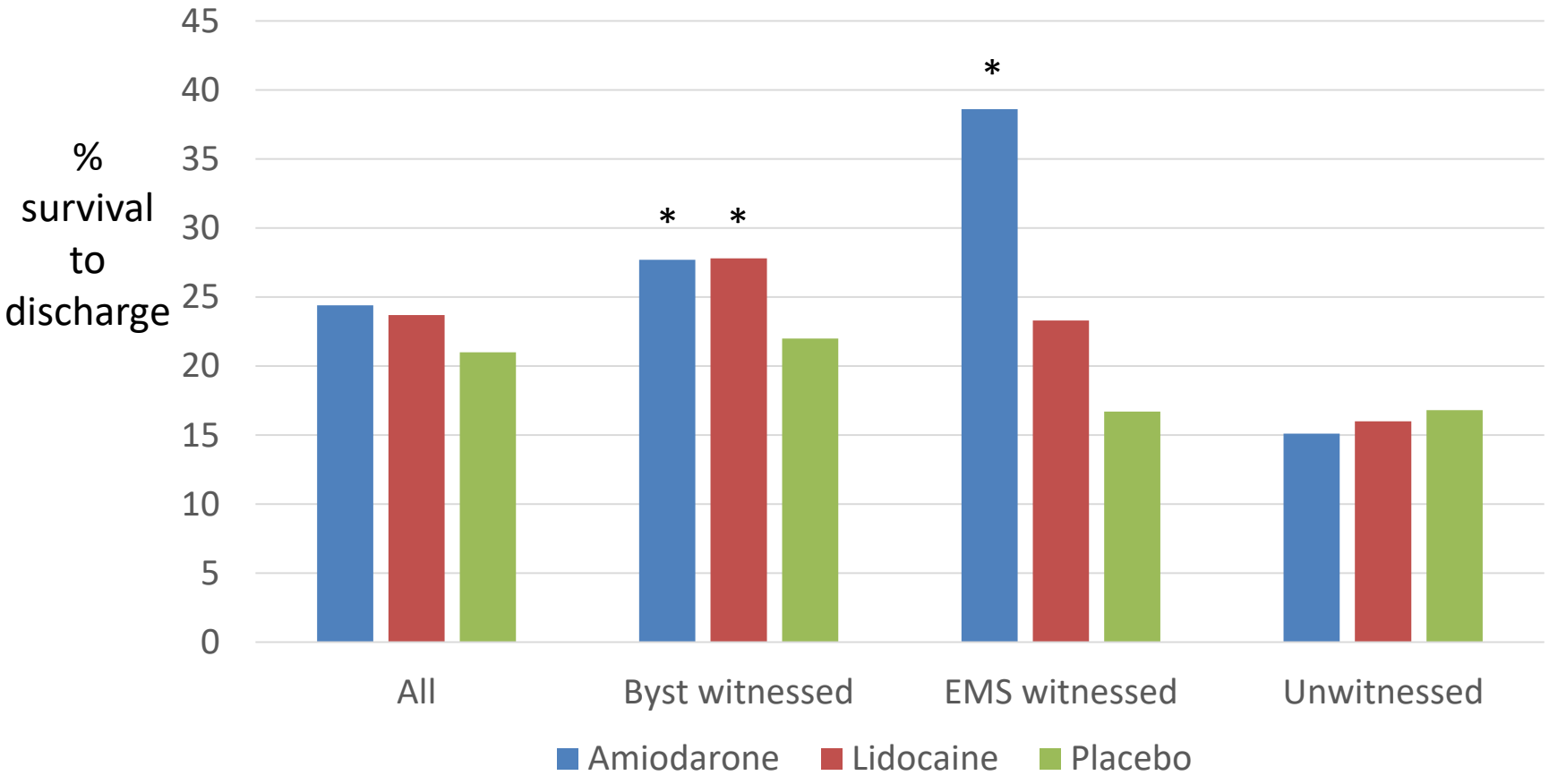
Improved survival



Amiodarone, Lidocaine, or Placebo in Out-of-Hospital Cardiac Arrest

WARWICK CLINICAL TRIALS UNIT

P.J. Kudenchuk, S.P. Brown, M. Daya, T. Rea, G. Nichol, L.J. Morrison, B. Leroux,



NEJM 2016

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IRWAYS 2

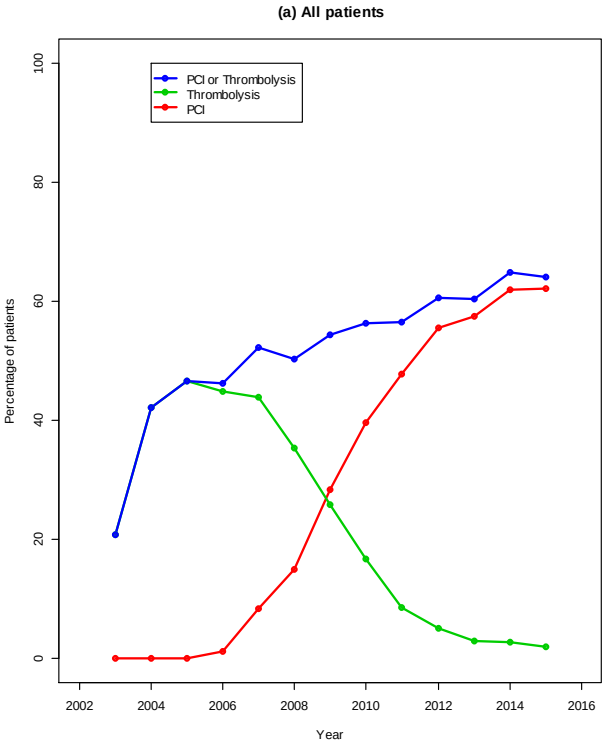
Airway management
in cardiac arrest patients

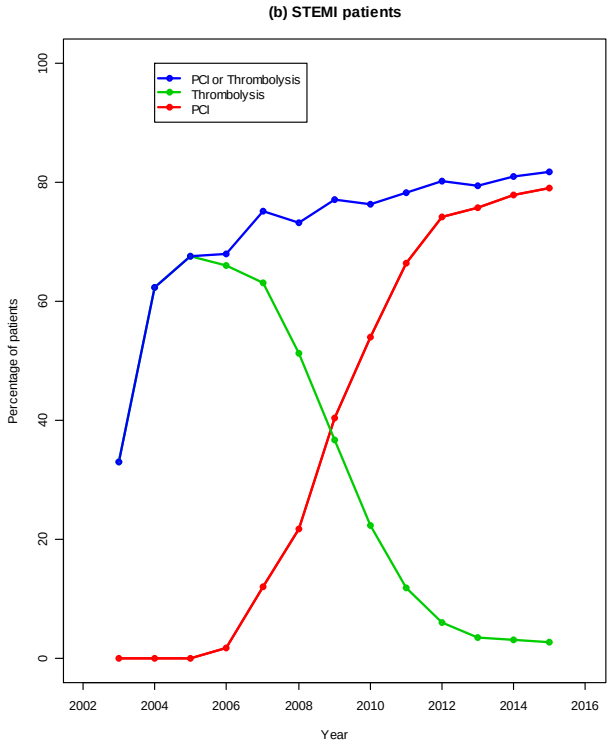
PARAMEDIC2

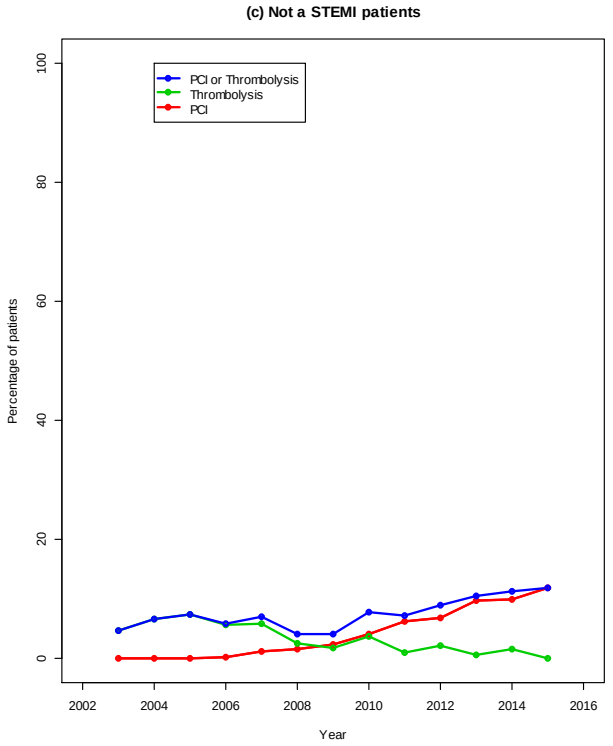
The Adrenaline Trial

HS&DR - 11/2004/30

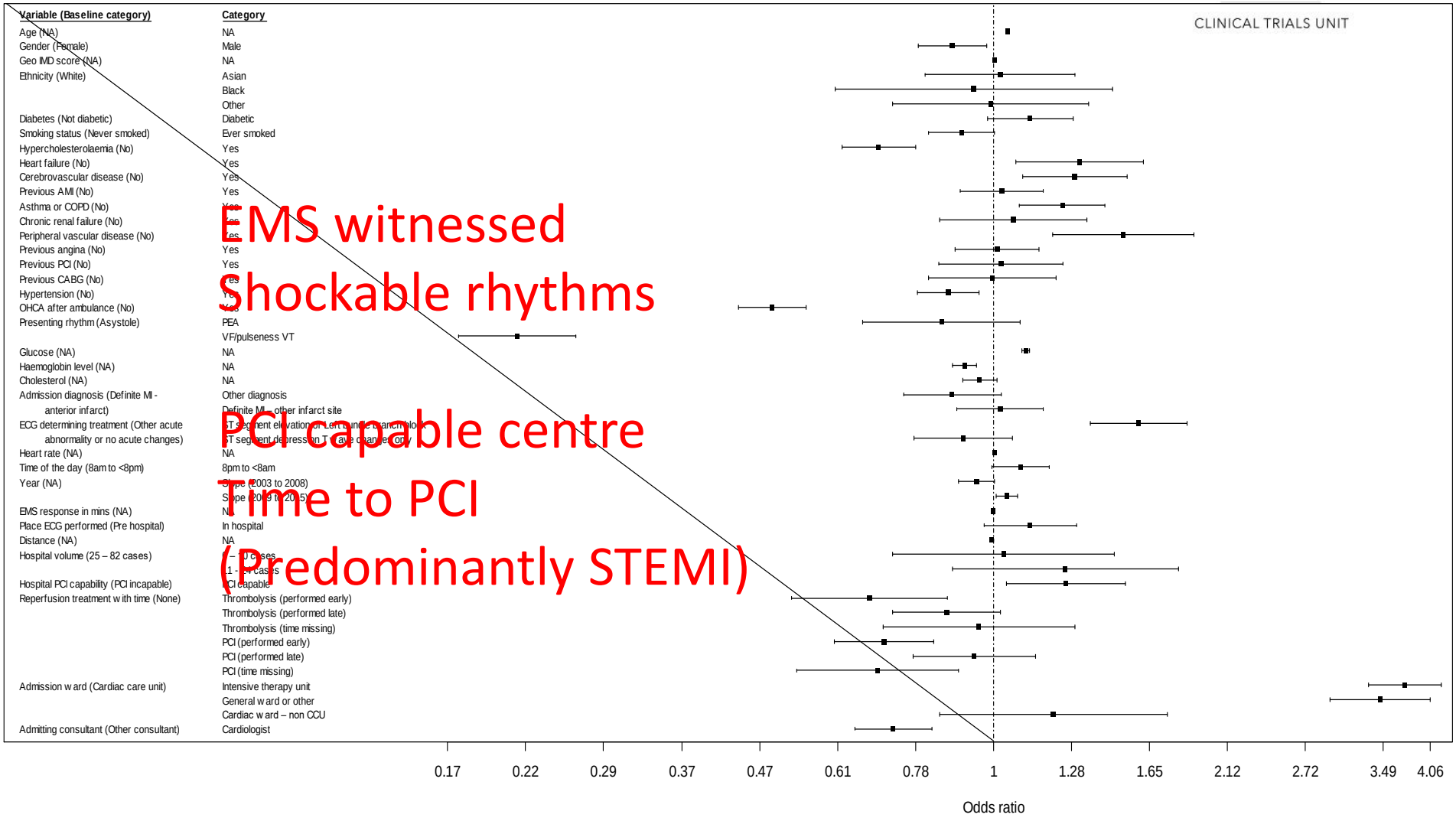
Why do outcomes of hospitalised patients with first out of hospital cardiac arrest from Acute Coronary Syndrome (ACS) vary in England and Wales?







Caterpillar plot for odds ratio of in-hospital mortality (adjusted analysis)



EMS witnessed

Shockable rhythms

PCI capable centre

Time to PCI

(Predominantly STEMI)

RESUSCITATION OUTCOMES CONSORTIUM

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Network for Emergency Care Clinical Trials: Strategies to Innovate EmeRgENcy Care Clinical Trials Network (SIREN) - Network Clinical Center (Hub) (U24)

Aus-ROC
Australian Resuscitation Outcomes Consortium

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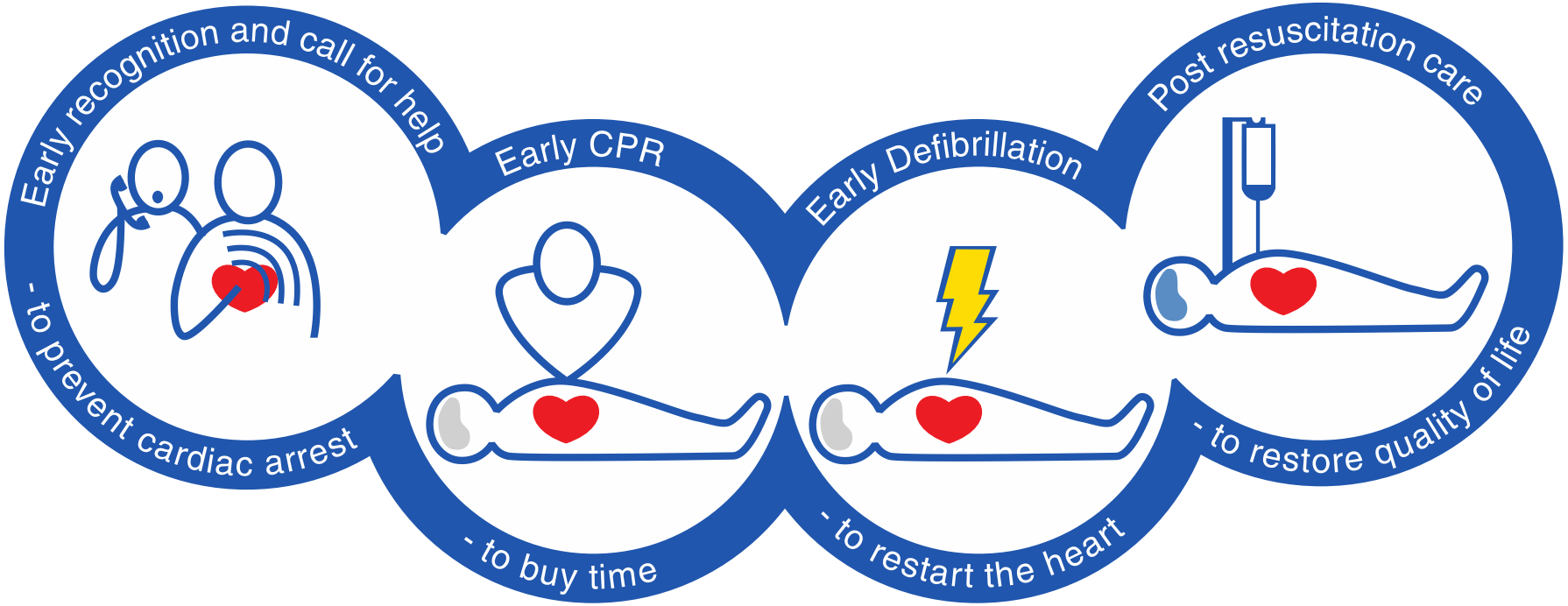

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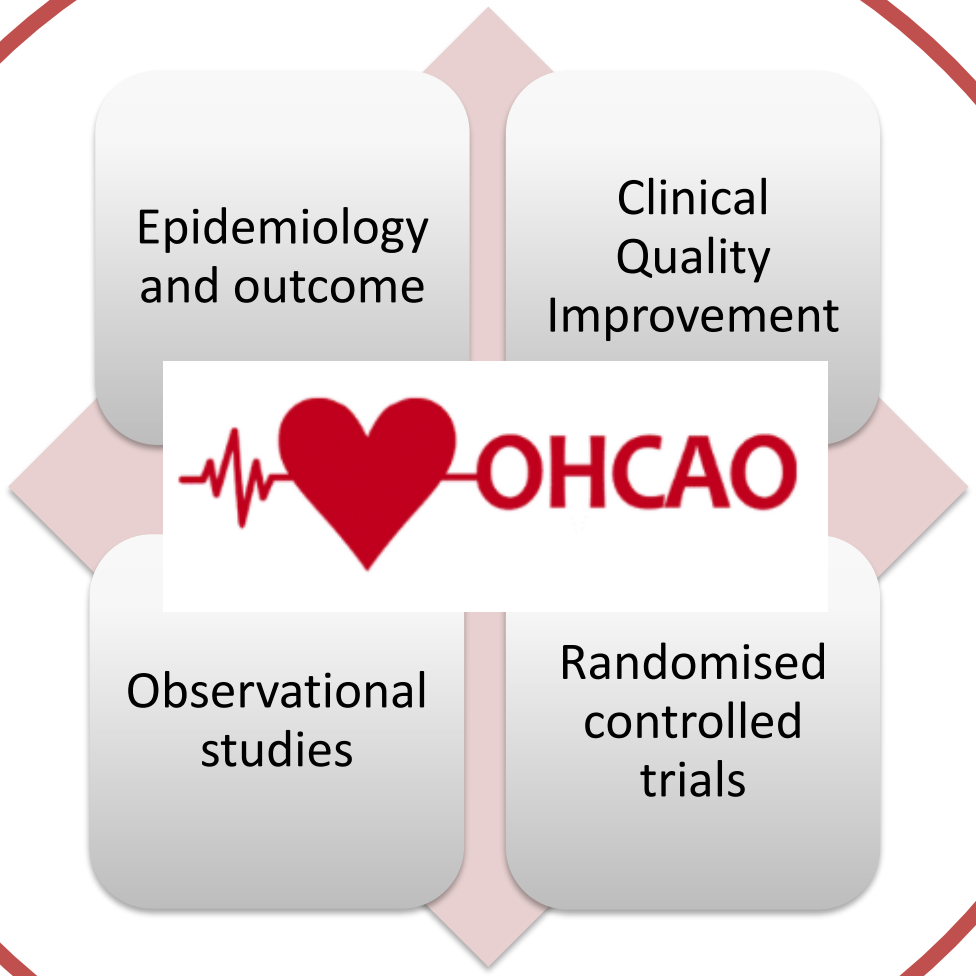

developing knowledge and capacity to save lives

UK-ROC

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developing knowledge and capacity to save lives

Summary

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- 28k cardiac arrests less than 1 in 10 survive
- System wide approaches early in Chain of Survival likely to have greatest impact
  - Dispatcher, CPR, Defibrillation
- Drive for excellence
- Research, audit, quality improvement