London Ambulance Service NHS Trust

Cardiac Arrest Annual Report: 2014/15

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Produced by:

Gurkamal Virdi, Scott Picton and Rachael Fothergill

✉ CARU.Enquiries@lond-amb.nhs.uk

Clinical Audit and Research Unit, Clinical and Quality Directorate, London Ambulance Service NHS Trust, 8-20 Pocock Street, London, SE1 0BW.

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Key findings

- In 2014/15, the LAS attended 10,211 cardiac arrests and attempted to resuscitate 4,665 of these patients.

- Figures from the national Ambulance Quality Indicators (2014/15) [1] demonstrate that the LAS performed very well in comparison to the other English ambulance services (despite seeing slight decreases in some clinical outcomes, see below). We ranked 2nd in the country for achieving ROSC on arrival to hospital (for all patients and the Utstein comparator group) and also ranked 2nd for survival to hospital discharge amongst the Utstein group. We performed above average for all cardiac arrest clinical outcome indicators (see Appendix 1 for comparisons against other Trusts and mean values).

- The proportion of patients achieving a pulse on arrival at hospital (return of spontaneous circulation - ROSC) remained relatively stable at around 31%. For the Utstein comparator group there was a small decrease in ROSC to 55.1% (from 58.5% in 2013/14).

- Survival to hospital discharge rates dropped from 10.3% to 9.0% for all patients where resuscitation was attempted and by 0.9% to 31.5% for those meeting the Utstein inclusion criteria (from 32.4% in 2013/14).

- Considerably more patients received bystander cardiopulmonary resuscitation (CPR) than ever before with 63.1% of patients receiving CPR prior to LAS arrival (from 55.8% in 2013/14).

- When a public access defibrillator was used (n=116), 76.7% of patients were reported to have sustained ROSC to hospital and the overall survival to discharge rate was 58.6%. This high survival rate demonstrates the importance of public access defibrillators.

- The percentage of patients whose arrest was bystander witnessed has remained stable with almost half having a witnessed arrest (49.2%).

- The presence of an initial shockable rhythm decreased slightly to 18.7% (from 21.5% in 2013/14).

- The majority of calls (94%) were identified as requiring a high priority response and were triaged as Category A ensuring ambulance staff were dispatched to the patient promptly.

- The median response time of 8 minutes was within target; although almost a minute longer than last year.

- A greater number of patients who achieved ROSC with evidence of myocardial infarction were taken to a Heart Attack Centre (HAC) compared with the previous year (362 vs. 297). The survival rate of these patients was 49.6%; considerably higher than the survival rate of presumed cardiac aetiology patients in general.

- Advanced Paramedic Practitioners (APP) are dispatched to cardiac arrests (either automatically or via enhanced triage by an APP) to manage resuscitation efforts. When an APP was present with primacy of care, ROSC sustained to hospital and survival to discharge rates were 33.8% and 10.3% respectively.

1. Introduction

The London Ambulance Service NHS Trust (LAS) provided an emergency response to 10,211 patients who suffered an out-of-hospital cardiac arrest in London between 1st April 2014 and 31st March 2015. Our staff delivered to these patients basic and/or advanced life support techniques in an attempt to resuscitate patients and, where possible, transported them to hospital for definitive care.

This report presents information regarding the response and treatment that our patients received, explores the factors present that may affect survival, and the outcomes of patients. Data have been sourced from the LAS cardiac arrest registry, which captures information from a range of clinical and operational sources including: Patient Report Forms (PRFs), vehicle Mobile Data Terminals (MDTs), 999 call logs and defibrillator data. Survival to hospital discharge information is collected using national databases and individual hospital patient records.

A breakdown of figures nationally, by LAS Complex and receiving hospital can be found in Appendices 1, 2 and 3. Appendix 4 is dedicated to a specific group of cardiac arrest patients that are conveyed to a Heart Attack Centre (HAC) following successful resuscitation as part of a specialist care pathway. Appendix 5 displays information according to the Clinical Commissioning Group (CCG) area in which the cardiac arrest occurred. Finally, Appendix 6 focuses on cardiac arrest patients under the age of 35.

A glossary of abbreviations and terms are included on page 14 for readers unfamiliar with the medical or Emergency Medical Service (EMS) terminology used.

2. Overview

Of the 10,211 out-of-hospital cardiac arrest patients attended, a resuscitation effort was not undertaken for 54.3% (n= 5,546) of cases. The vast majority of these patients were recognised as deceased on arrival (91.9%; n=5,098) and 8.1% (n=448) had a Do Not Attempt CPR (DNA-CPR) order - or similar equivalent - in place, or the patient's death was expected.

Resuscitation was attempted by LAS staff for 45.7% (n=4,665) of all cardiac arrest patients. The remainder of this report focuses on these patients and Table 1 (overleaf) provides an overview of the patient demographics and clinical presentation, call and response information, and interventions provided by the LAS.

Gender	
Male	62.9%; n=2,933
Female	37.1%; n=1,731
Unknown	0%; n=1

Age (years)	
Overall average	66
Male average	64
Female average	69

Race□^	
White	61.6%; n=2,873
Asian	7.5%; n=348
Black	6.6%; n=306
Mixed	0.2%; n=7
Other	3.6%; n=166
Unable to obtain	17.5%; n=818
Not documented	3.2%; n=147

Peak occurrence	
Time of day (hours)	08:00-11:59 23.2%; n=1,081
Day	Sunday 14.8%; n=691
Month	December 11.1%; n=516

Chief Complaint	
Cardiac arrest	52.1%; n=2,430
Other	47.9%; n=2,235

Response category□	
R1	64.3%; n=3,001
R2	29.7%; n=1,385
C1	1.4%; n=66
C2	3.1%; n=146
C3	0.8%; n=39
C4	0.6%; n=28

Response times (median in minutes)	
999 call - scene	07:38
999 call - CPR#	09:11
999 call - defibrillation◊	12:39

□ *The total percentages do not equal 100% due to rounding.*

^ *This data should be viewed with caution as definitive information is not routinely obtainable.*

 # Figures exclude arrests witnessed by LAS staff.

◊ Figures are based on patients with an initial rhythm of VF/VT and exclude arrests witnessed by LAS staff.

Location	
Private	77.7%; n=3,626
Public	22.3%; n=1,039

Witnessed□	
Bystander	49.2%; n=2,293
LAS	17.6%; n=819
Unwitnessed	33.2%; n=1,548
Not documented	0.1%; n=5

Bystander CPR#	
Yes	63.1%; n=2,427/3,846
No	36.9%; n=1,419/3,846

Initial rhythm	
Asystole	53.3%; n=2,486
PEA	26.4%; n=1,230
VF/pulseless VT	18.7%; n=873
Not documented	1.6%; n=76

Aetiology⊗	
Presumed cardiac	85.9%; n=4,006
Other medical	3.4%; n=159
Trauma	4.5%; n=209
Asphyxiation	3.2%; n=150
Overdose	2.6%; n=123
Drowning	0.3%; n=15
Electrocution	0.1%= n=3

Airway management*	
Airway placed	87.8%; n=4,096/4,665
ETT success rate	82.8%; n=1,469/1,775
SGA success rate	90.1%; n=3,149/3,494
$ETCO_2$ measured	96.3%; n=3,946/4,096

Resuscitation terminated on scene	
Yes, by LAS	33.1%; n=1,544
Yes, by other Healthcare Professional	3.8%; n=177
No	63.1%; n=2,944

⊗ *This data cannot be compared with previous years due to differences in classification of aetiology following updated Utstein definitions.*

** Airway management refers to the application of an advanced airway intervention, including endotracheal tube (ETT) and supraglottic airway device (SGA). End tidal carbon dioxide (ETCO2) is measured to assess the accurate placement of these devices.*

Table 1 – Overview of all cases where resuscitation was attempted (n=4,665).

3. ROSC sustained to hospital and survival to hospital discharge

3.1. All patients for whom resuscitation was attempted

1,465 of the 4,665 patients (31.4%) for whom resuscitation attempted maintained ROSC to hospital, which is a slight increase from last year's rate of 31.2%. The rate of survival to discharge for this group was 9.0% (n=414/4,595); a decrease of 1.3% from 2013/14.

ROSC sustained to hospital	
Yes	31.4%; n=1,465
No	68.4%; n=3,193
Not Documented	0.2%; n=7

Survived to discharge+	
Yes	9.0%; n=414/4,593
No	91.0%; n=4,181/4,595

+ Denominator excludes patients with unknown survival outcomes (n=70).

Table 2 – ROSC sustained to hospital and survival to discharge where resuscitation was attempted.

3.2. All patients for whom resuscitation was attempted – subgroup analyses

The Utstein template is an internationally recognised system enabling comparisons of patient outcomes amongst EMS providers. In 2014, the Utstein template[2] was updated to allow analysis of outcomes for comparator sub-groups irrespective of aetiology: bystander witnessed arrests with a shockable (VF/pulseless VT) initial heart rhythm, bystander witnessed arrests with non-shockable rhythms, and arrests where bystander CPR was undertaken and a shockable rhythm was present.

Comparator groups	ROSC sustained to hospital	Survival to discharge+
Bystander witnessed arrests with shockable rhythms*	54.2%; n=301/555	31.1%; n=166/534
Bystander witnessed (other rhythms)*	31.8%; n=553/1,738	3.5%; n=60/1,718
Bystander CPR with VF/VT*	53.3%; n=279/523	31.0%; n=157/506

+ Denominators exclude patients with unknown survival outcomes.
** Figures exclude arrests witnessed by LAS staff.*

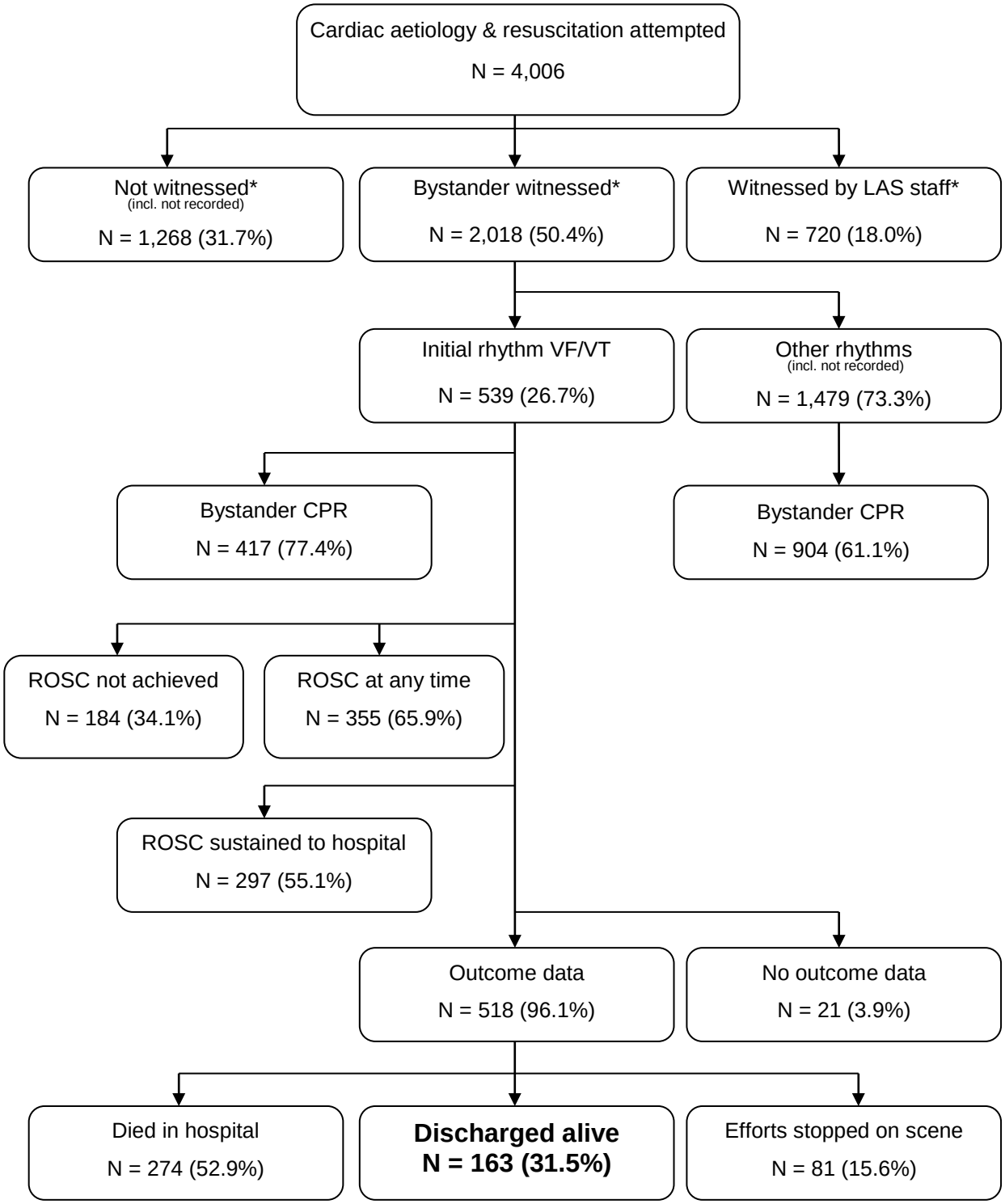
Table 3 – ROSC sustained to hospital and survival to discharge for all resuscitation attempted cases.

3.3. Utstein survival

The Utstein survival calculation[3] used in this report examines patients where resuscitation was attempted and focuses on those where: the arrest was of a presumed cardiac aetiology, bystander witnessed, and in a shockable rhythm (VF/pulseless VT) on arrival of the EMS.

Figure 1 shows that ROSC was sustained to hospital for 55.1% (n=297/539) of patients; a decrease of 3.4% from 2013/14. Survival to discharge was achieved for 31.5% (n=163/518); a marginal decrease of 0.9% from the previous year.

Figures 2 and 3 show the ROSC sustained to hospital and survival to discharge rates over time; showing both the improvements and fluctuations observed in rates.



** The total percentage does not equal 100% due to rounding.*

Figure 1 – Outcome for the Utstein comparator group

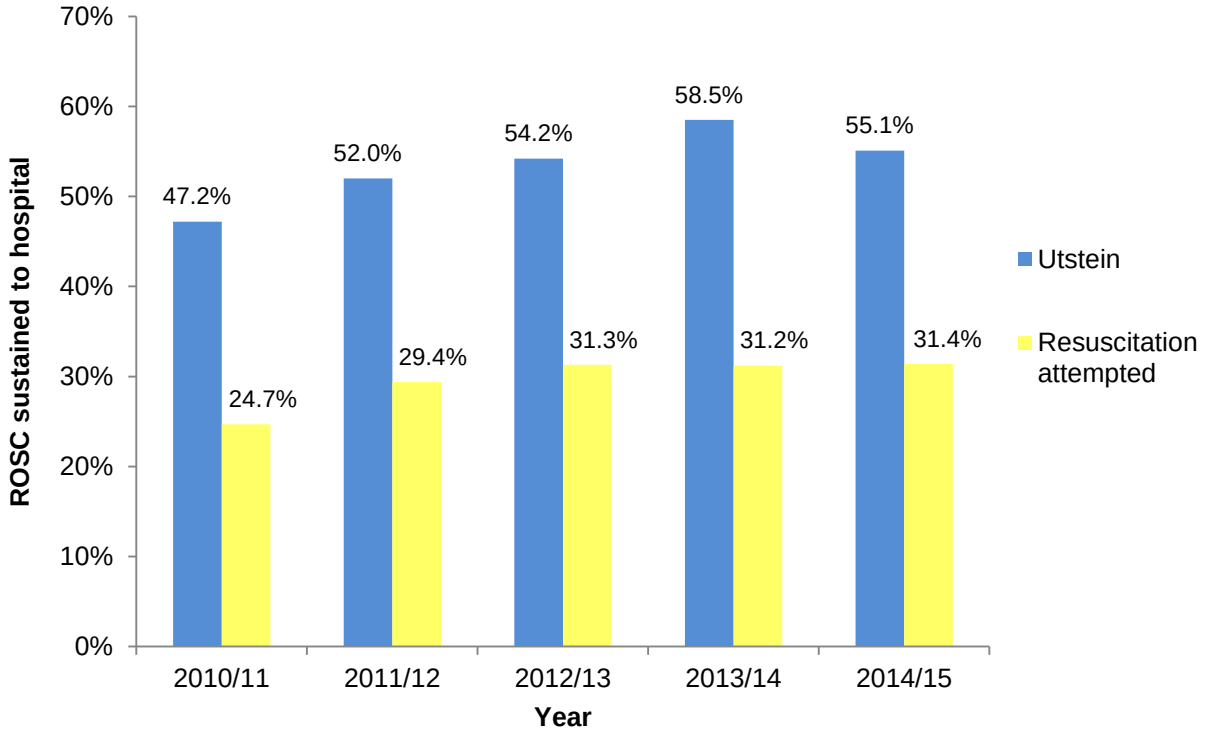


Figure 2 – ROSC sustained to hospital for the Utstein comparator group and all resuscitation attempted patients by year.

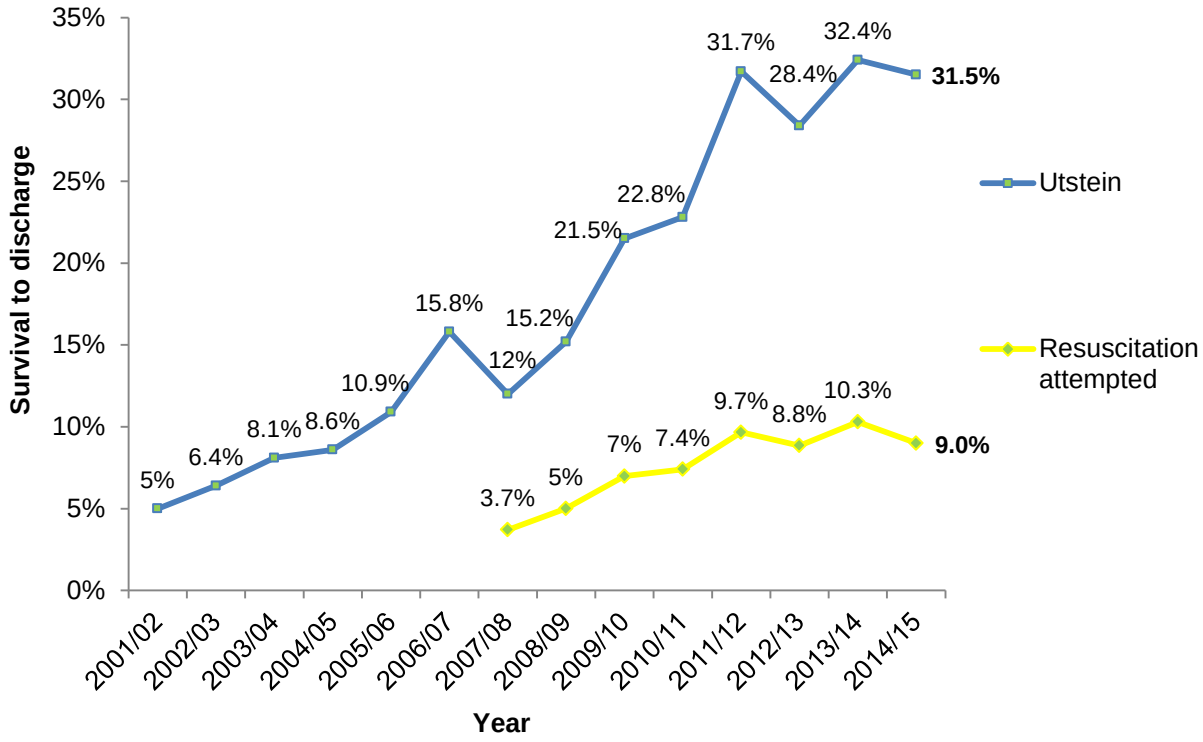


Figure 3 – Survival to discharge for the Utstein comparator group and all resuscitation attempted patients by year.

3.4. EMS only witnessed arrests

The table below shows the outcomes of the 819 cardiac arrest patients whose arrest was witnessed by LAS staff.

EMS witnessed arrest outcomes	
ROSC sustained to hospital	36.5%; n=299/819
Survived to discharge	16.8%; n=134/800

+ Denominator excludes patients with unknown survival outcomes (n=19)

Table 4 – ROSC sustained to hospital and survival to discharge where resuscitation was attempted.

The majority of patients where the arrest was EMS witnessed had an initial rhythm of PEA (47.1%; n=386). Of these, ROSC was sustained to hospital in 26.2% (n=101) of patients and 5.8% (n=22/380) survived to discharge from hospital. Where the patient was in an initial rhythm of VF/pulseless VT (22.8%; n=187), patients were considerably more likely to sustain ROSC to hospital (65.2%; n=122) and survive to hospital discharge (53.8%; n=98/182). Asystolic patients (27.5%; n=225) had a ROSC sustained to hospital rate of 28.9% (n=65) and survival to discharge rate of 5.5% (n=12/220).

4. Factors influencing outcomes

The factors that influence the chances of positive outcomes for patients who suffer a cardiac arrest are complex. This section presents some of the key factors that affect patient outcomes.

4.1. Bystander intervention

Bystanders have a crucial role in the chain of survival. Our Emergency Medical Dispatchers will provide CPR instructions at the point of the 999 call to bystanders prior to the arrival of the LAS. Furthermore, during 2014/15, over 1000 public access defibrillators were established at locations across London as part of the ‘Shockingly Easy’ campaign and we continued to teach life-saving skills to members of the public.

4.1.1. Bystander CPR and bystander witnessed arrests

Figure 4 below shows the increases in rates of bystander CPR and witnessed rates over the last 5 years, including this years’ record high rates of 63.1% and 49.2% respectively.

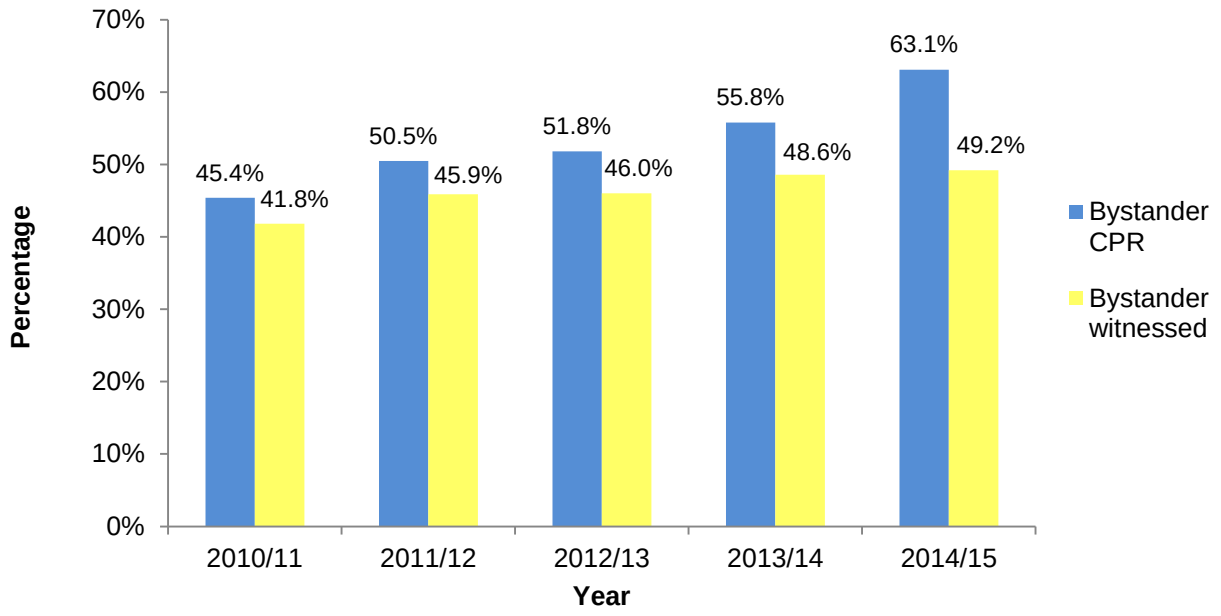


Figure 4 – Rates of bystander CPR and witnessed arrests for all resuscitation attempted patients.

4.1.2. Public Access Defibrillator use

In 2014/15, a public access defibrillator was deployed by members of the public in 116 of cardiac arrest incidents. In 43 cases the defibrillator was not used as it was either not indicated or ambulance staff arrived on scene prior to its use. For the remaining 73 cases the defibrillator was applied and at least one shock given. Further event information for these patients is given below:

Public Access Defibrillator Use	
Bystander witnessed:	67.1%; n=49
Bystander CPR:	71.2%; n=52
ROSC sustained to hospital:	76.7%; n=56
Survival to discharge[+]:	58.6%; n=41/70

+ Denominator excludes patients with unknown survival outcomes (n=3)

Table 5 – Public Access Defibrillator use event information and patient outcomes.

4.2. Location of cardiac arrest

The majority of arrests where resuscitation was attempted occurred at home (n=3,198). Survival was more likely from arrests that occurred in public locations, with leisure centres/ sports clubs (29.7%), work (28.7%) and public transport (26.5%) having the highest survival rates.

Private (n=3,626)	No.	Witnessed	Bystander CPR	Survival to Discharge[+]
Home	3,198	56.7% (1,476/2,603)	57.9% (1,506/2,603)	6.8% (215/3,155)
Care home	428	58.7% (209/356)	76.1% (271/356)	1.6% (7/427)

Public (n=961)	No.	Witnessed	Bystander CPR[#]	Survival to Discharge[+#]
Street	501	68.9% (297/431)	67.7% (292/431)	15.3% (74/485)
Work	98	64.9% (50/77)	77.9% (60/77)	28.7% (27/94)
Healthcare facility (e.g. GP surgery, walk in centre)	85	62.3% (43/69)	94.2% (65/69)	17.9% (15/84)
Public transport	68	73.3% (44/60)	61.7% (37/60)	25.0% (17/68)
Social Venue (e.g. Pub, Restaurant, Cinema)	66	87.7% (50/57)	80.7% (46/57)	25.0% (16/64)
Shop/ Bank	44	80.0% (28/35)	68.6% (24/35)	20.9% (9/43)
Hotel/ Hostel	38	60.6% (20/33)	69.7% (23/33)	13.5% (5/37)
Leisure Centre/Sports Club	37	90.6% (29/32)	90.6% (29/32)	29.7% (11/37)
Parkland/Woodland/River	31	41.4% (12/29)	75.9% (22/29)	9.7% (3/31)
Airport	22	78.9% (15/19)	78.9% (15/19)	22.7% (5/22)
Other (e.g. School, Prison, Place of Worship)	49	44.4% (20/45)	82.2% (37/45)	20.8% (10/48)

+ Denominators exclude patients with unknown survival outcomes.
 # Please view with caution due to small numbers.

Table 6 – Location of cardiac arrests where resuscitation was attempted.

4.3. Initial rhythm

Patients who present in a shockable rhythm (VF/pulseless VT) have the best chance of surviving their arrest. Figure 5 below shows the changing presentation of initial arrest rhythms over the last five years with VF/VT rates decreasing this year to 18.7% (from 21.5% in 2013/14). This will have an impact on patient outcomes as patients with an initial rhythm of VF/VT have considerably higher rates of ROSC sustained to hospital and survival to discharge (55.6% and 32.4% respectively).

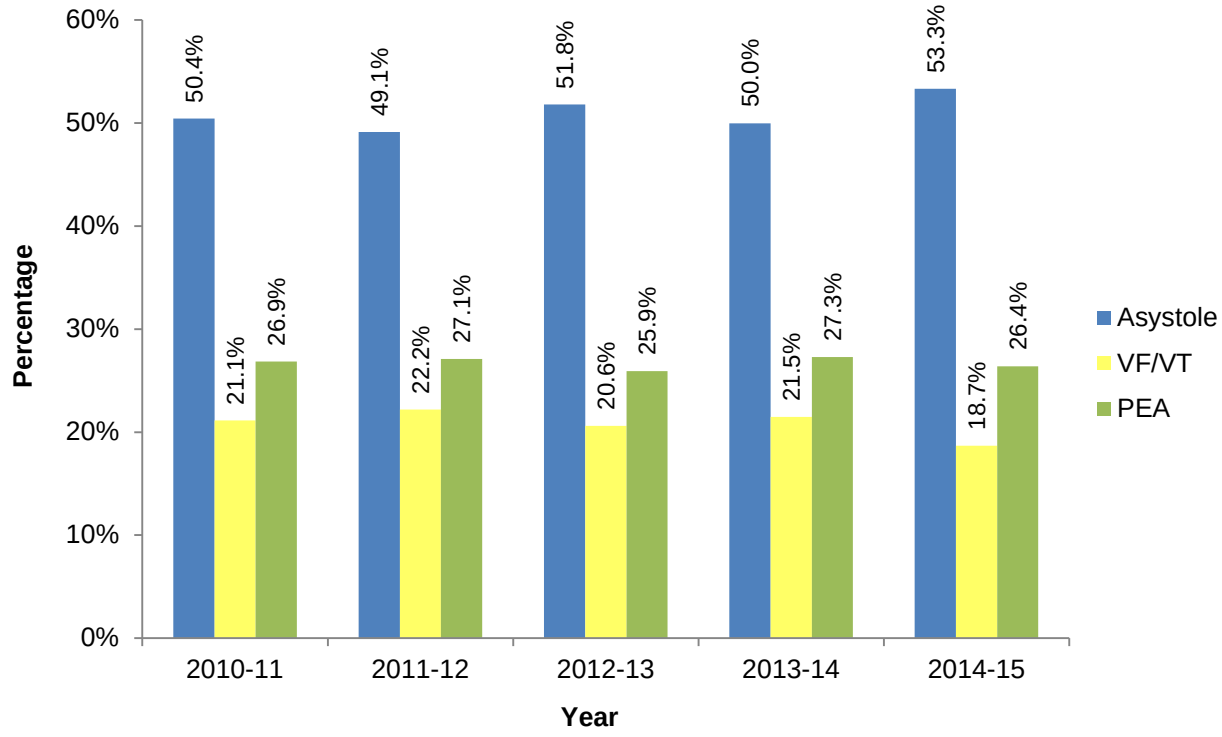


Figure 5 – Rates of initial rhythm for all resuscitation attempted patients.

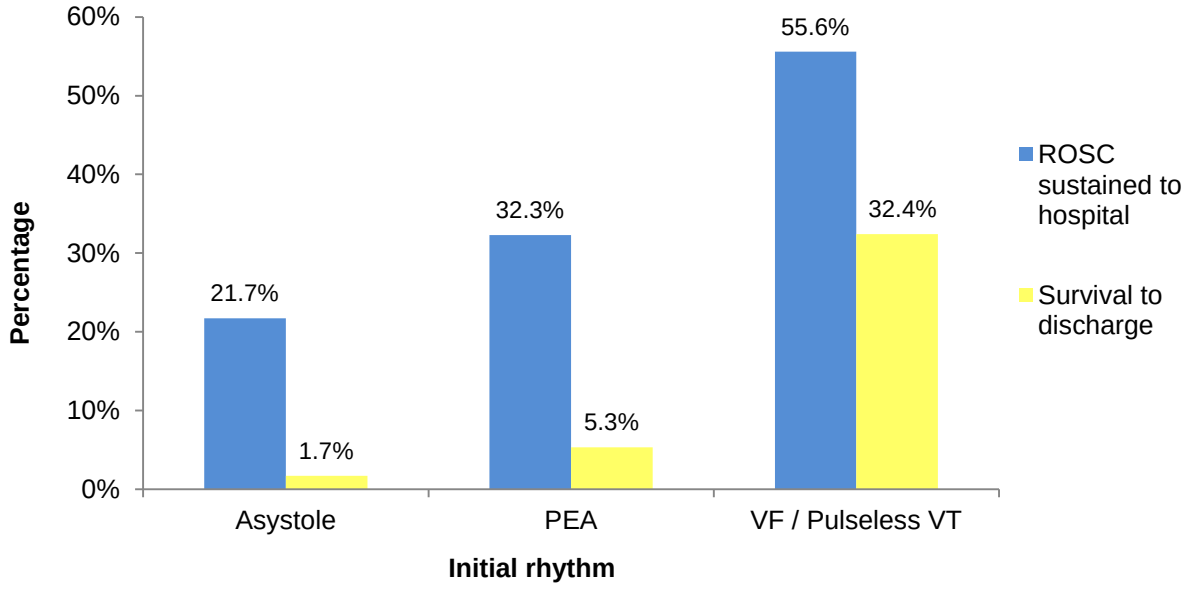


Figure 6 – Initial rhythm compared with ROSC sustained to hospital and survival to discharge for all resuscitation attempted patients.

4.4. Aetiology

The cause of a cardiac arrest affects the outcome and is an important factor in determining the recognition of reversible causes. The most frequent aetiology of arrest was presumed cardiac (85.9%; n=4,006). The remaining aetiologies include other medical causes, trauma from external causes (such as penetrating and blunt injuries), asphyxia (such as respiratory obstruction and asphyxiation from hangings or suffocation), drowning, electrocution and overdose.

Cause		No.	Initial Rhythm^			ROSC sustained to hospital#	Survived to discharge#+
			Asystole	PEA	VF/VT		
Presumed cardiac		4,006	51.6% (2,066)	26.0% (1,043)	21.2% (851)	32.5% (1,302)	9.4% (371/3,951)
Other Medical⊗	Terminal illness	121	70.2% (85)	24.0% (29)	5.0% (6)	9.1% (11)	0% (0/121)
	Neonatal	13	38.5% (5)	-	-	15.4% (2)	0% (0/10)
	Asthma/COPD	10	40.0% (4)	50.0% (5)	10.0% (1)	70.0% (7)	50.0% (5/10)
	Pulmonary embolism	5	40.0% (2)	40.0% (2)	20.0% (1)	20.0% (1)	0% (0/5)
	Internal bleeding	3	33.3% (1)	66.7% (2)	-	0% (0)	0% (0/3)
	Hypothermia	2	-	100.0% (2)	-	0% (0)	0% (0/2)
	Anaphylaxis	2	50.0% (1)	50.0% (1)	-	100.0% (2)	0% (0/2)
	Infection	1	-	100.0% (1)	-	0% (0)	0% (0/1)
	Epilepsy	1	-	-	-	100.0% (1)	100% (1/1)
	Stroke	1	-	100.0% (1)	-	0% (0)	0% (0/1)
	Total	*159*	*61.6% (98)*	*27.0% (43)*	*5.0% (8)*	*15.1% (24)*	*3.9% (6/156)*
Trauma⊗	Road Traffic Collision	85	50.6% (43)	41.2% (35)	2.4% (2)	12.9% (11)	4.8% (4/84)
	Fall from height	39	56.4% (22)	38.5% (15)	-	2.6% (1)	0% (0/39)
	Stabbing	36	63.9% (23)	36.1% (13)	-	11.1% (4)	0% (0/36)
	Blunt trauma	10	40.0% (4)	50.0% (5)	-	0% (0)	0% (0/10)
	Haemorrhage	12	50.0% (6)	50.0% (6)	-	8.3% (1)	0% (0/11)
	Fall down stairs	8	75.0% (6)	12.5% (1)	-	50.0% (4)	0% (0/7)
	Blunt assault	7	71.4% (5)	14.3% (1)	14.3% (1)	14.3% (1)	0% (0/7)
	Hit by train	3	33.3% (1)	33.3% (1)	-	33.3% (1)	0% (0/3)
	Head injuries	5	40.0% (2)	20.0% (1)	40.0% (2)	40.0% (2)	20.0% (1/5)
	Shooting	3	100.0% (3)	-	-	0% (0)	0% (0/3)
	Burns	1	100.0% (1)	-	-	0% (0)	0% (0/1)
	Total	*209*	*55.5% (116)*	*37.3% (78)*	*2.4% (5)*	*12.0% (25)*	*2.4% (5/206)*
Asphyxial⊗	Asphyxiation	82	82.9% (68)	14.6% (12)	-	34.1% (28)	5.1% (4/79)
	Obstruction	62	50.0% (31)	43.5% (27)	1.6% (1)	50.0% (31)	11.5% (7/61)
	Smoke inhalation	6	66.7% (4)	33.3% (2)	-	50.0% (3)	0% (0/5)
	Total	*150*	*68.7% (103)*	*27.3% (41)*	*0.7% (1)*	*41.3% (62)*	*7.6% (11/145)*
Overdose		123	74.0% (91)	17.9% (22)	4.9% (6)	36.6% (45)	14.7% (18/122)
Drowning		15	73.3% (11)	13.3% (2)	6.7% (1)	33.3% (5)	7.1% (1/14)
Electrocution		3	33.3% (1)	33.3% (1)	33.3% (1)	66.7% (2)	66.7% (2/3)

^ Not documented values (n=76) are not presented.
 # Please view with caution due to small numbers.
+ Denominators exclude patients with unknown survival outcomes.
⊗*This data cannot be compared with previous years due to differences in classification of aetiology following updated Utstein definitions.*

Table 7 – Aetiology of all cases where resuscitation was attempted.

4.5. Advanced Paramedic Practitioners (APPs)

In May 2014, the LAS launched the role of Advanced Paramedic Practitioners (APPs). APPs are trained in a greater range of assessments and skills, and carry mechanical CPR devices, ultrasound equipment for assessment of reversible causes and ventilator devices for use post ROSC. APPs are dispatched to cardiac arrests (either automatically or via comprehensive triage by an APP based in the Emergency Operations Centre) to manage resuscitation efforts and provide enhanced care to patients.

When an APP was present with primacy of care (n=853), the ROSC sustained to hospital rate was 33.8% (n=288) and survival to discharge was 10.3% (n=87/843).

4.6. Resuscitated patients conveyed to Heart Attack Centres (HACs)

During 2014/15, 362 patients who achieved a stable ROSC following an arrest of presumed cardiac origin presented with a STEMI on a 12-lead ECG and were conveyed directly to a HAC as part of a specialist care pathway. Survival to discharge for these patients was higher than other groups at 49.6% (n=174/351). A breakdown of survival and initial rhythm for these patients by all eight London HACs can be found in Appendix 4.

5. Discussion

This year, we have seen a decrease in survival (by 1.3% for all patients where resuscitation was attempted, and 0.9% for the Utstein comparator group). ROSC sustained to hospital increased slightly (by 0.2%) for all patients who had resuscitation commenced and decreased (by 3.4%) for the Utstein group. Given that there have been fluctuations in rates in previous years (see Figures 2 and 3), and these changes in ROSC sustained to hospital and survival to discharge are minimal, the LAS can be reassured that the quality of care delivered to patients continues to be of a high standard. Furthermore, we compare favourably against other English ambulance services, ranking 2nd for three of the four cardiac arrest clinical outcome measures (see Appendix 1).

The profile of patient characteristics and clinical presentations reported have remained relatively stable (i.e. gender, age, location of arrest, whether or not the arrest was bystander witnessed and aetiology). Changes have been observed in initial rhythms where shockable VF/pulseless VT rhythms have decreased by 2.8% to 18.7% (from 21.5% in 2013/14) and this may have impacted on patient outcomes given that this group of patients have a higher survival rate than patients in other rhythms. Decreases in VF/pulseless VT have been observed world-wide in recent years and are reflective of ageing populations and co-morbidities.[2]

Our response to patients has been within the NHS England target of 8 minutes[1], with a median time of 7 minutes and 38 seconds. However, it is important to note that this is nearly a minute longer than last year. It is recognised that response times will have an impact on survival.[4]

Bystander CPR rates have increased by 7.3% to 63.1% (from 55.8% in 2013/14), and the numbers of patients where a public access defibrillator has been used have increased dramatically from 18 in 2013/14 to 73 in 2014/15. The outcome of patients where a public access defibrillator has been used remain high at 58.6%.

We have also introduced the role of APP and can demonstrate that where an APP is dispatched to support resuscitation efforts patient outcomes are robust, with a ROSC sustained to hospital rate of 33.8% and survival to discharge rate of 10.3%.

Patients conveyed to a HAC under the specialist care pathway for post ROSC patients with clear evidence of a STEMI on their ECG have continued to demonstrate higher survival rates than all other groups (49.6%).

In addition to the placement of public access defibrillators, introduction of APPs and use of the specialist HAC pathway, the LAS has introduced mechanical CPR to our experienced clinicians. To ensure that are cardiac arrest patients receive the highest standards of clinical care, we have reviewed and updated our cardiac care guidelines for basic and advanced life support practices and trauma care. We maintained the delivery of full energy defibrillation shocks of 360 joules to patients in shockable rhythms, and have also enabled our APPs to provide double sequential defibrillation in patients in refractory VF. We have also updated our guidelines on the use of adrenaline and placed an upper threshold of 10 doses, based on evidence of poor outcome of patients with a greater number of doses.

The LAS has continued to provide education to staff via Clinical Skills Refresher courses and to Team Leaders through clinical update sessions. The concept of Crew Resource Management has continued to be embedded and the APPs have supported this through the provision of both on-scene and virtual leadership of cardiac arrest incidents (alongside Medical Directorate colleagues) as well as staff support through post resuscitation debriefs.

We successfully commenced the pilot of the Paramedic 2 research project – a randomised double blind controlled trial examining adrenaline use in cardiac arrest patient outcomes. We also have completed a small pilot of the Immediate Coronary Angiography After Ventricular Fibrillation Out-Of-Hospital Cardiac Arrest (ARREST) randomised control trial – where a small group of cardiac arrest patients have been taken directly to a HAC to receive angiography with a view to undertaking primary angioplasty as necessary. In 2015/16 both projects will extend beyond the pilot stage to fully active research projects. Finally, we are also exploring new resuscitation technologies and continuing to enhance the APP role by augmenting their clinical skills and introducing greater numbers of APPs pan-London.

It is hoped that the initiatives we have planned and our continued investment in our staff will ensure improvements in future years.

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Glossary for abbreviations and terms

Advanced Life Support – Includes skills such as advanced airway management, manual defibrillation, cannulation and drug administration.

Angiography – A procedure performed at a Heart Attack Centre to check the blood flow in the coronary arteries.

Automated External Defibrillator (AED) – A portable defibrillator that automatically diagnoses if the heart is in a rhythm that can be shocked and if so delivers a shock.

Basic Life Support – Includes skills such as CPR, manual airway positioning and AED use.

Bystander – A lay person or non-Emergency Medical Service personnel.

Category A – Red 1 and Red 2 form part of a Category A - an immediately life threatening - response. In line with national definitions, 999 call is defined as the time at which the chief complaint is established or one minute elapses, whichever comes first.

Chain of survival – A concept that refers to the elements that are associated with survival; early recognition of cardiac arrest and access to EMS systems, CPR, defibrillation and advanced care.

Chief Complaint – The primary medical reason that the caller has called 999 as defined by the call triage system.

Complex – Each of the LAS Clusters are subdivided into several smaller operational areas known as Complexes. Please note that these do not necessarily align with Clinical Commissioning Group areas.

Defibrillators – The LAS use portable defibrillators to help diagnose the heart's rhythm and deliver a pre-set charged shock of 360J. LAS staff use both AEDs and manual defibrillators, and are able to use an override to enable CPR to be continued whilst the AED is charging.

Double sequential defibrillation – uses two defibrillators to provide multiple high energy shocks in refractory VF to help terminate the rhythm.

Electrocardiogram (ECG) – The LAS use 12-lead ECGs to diagnose STEMIs.

Emergency Medical Dispatchers (EMDs) – Staff based in the LAS Emergency Operations Centre that answer 999 calls and dispatch resources to patients.

Emergency Medical Technician (EMT) – A clinical grade below that of a paramedic with 4 different levels (1-4). EMT Level 4s are able to place the SGA advanced airway in cardiac arrest patients.

Endotracheal Tube (ETT) – Type of advanced airway that some paramedic staff are able to place.

End-Tidal Carbon Dioxide ($ETCO_2$) – Measurement of gas exchange in lungs which enables a clinician to accurately tell whether an airway device has been placed correctly, and allows other information such as effectiveness of compressions and ventilations to be ascertained. ETCO2 measurement is compulsory for patients where an advanced airway has been placed.

Heart Attack Centre (HAC) – Specialist centres in London hospitals to which patients suffering a STEMI are taken directly for angiography and primary Percutaneous Coronary Intervention (pPCI).

Initial rhythm – The rhythm that the heart is in on initial presentation to LAS staff.

Mobile Data Terminal (MDT) – The device used by clinical staff to receive incoming call information and navigate to the location.

Paramedic – A majority of clinical staff are paramedics and are able to perform advanced airway management, cannulation and administration of drugs to cardiac arrest patients.

Patient Report Form (PRF) – The document used by the LAS to record all aspects of patient care and treatment.

Primary Percutaneous Coronary Intervention (pPCI) – A surgical procedure performed at a Heart Attack Centre which seeks to unblock arteries by means of insertion of a catheter into the affected artery and inflating a small balloon to re-open it. The opened artery is then held in place with a small stent.

Recognition of Life Extinct (ROLE) – The LAS will recognise if life is extinct if there are signs unequivocal with life present or there is evidence of a prolonged period of cardiac arrest with no attempt at basic life support (BLS) prior to the arrival of the LAS. ROLE can be used upon arrival of a clearly deceased patient, or after resuscitation has been attempted.

Response Category: R1 – Red 1 is used for calls where the patient is not breathing and are classed as the most time critical.

Response Category: R2 – Red 2 is used for calls where the complaint is serious but slightly less immediately time critical.

Response Category: C1 to C4 – All other calls are given a Category C response based on the information provided by the caller regarding the patient's condition. The 999 call time definition is the same as Category A calls.

Return of Spontaneous Circulation (ROSC) – Refers to a return of cardiac output by the heart after a period of cardiac arrest. ROSC sustained to hospital is the most widely used measure for out-of-hospital cardiac arrests and indicates the patient had ROSC at handover to hospital staff.

Supraglottic Airway Device (SGA) – Type of advanced airway that all clinical staff from EMT4 upwards have the skill to place.

Survival to Discharge – The patient was successfully discharged from a hospital to a non-hospital environment (therefore excluding transfers from one hospital to another).

Utstein – Refers to the internationally recognised criteria for outcomes. The patients in this group are all witnessed having a cardiac arrest by a bystander, all present with an initially shockable rhythm of VF or pulseless VT and have a presumed cardiac aetiology.

Witnessed – Either seen or heard by a bystander or seen by LAS staff.

Appendix 1: National comparisons

Return of spontaneous circulation (ROSC) at time of arrival at hospital (Overall)

		Incidents	Performance (%)
South Central Ambulance Service NHS Trust	38.5	1,486	38.5
London Ambulance Service NHS Trust	31.4	4,665	31.4
North West Ambulance Service NHS Trust	29.6	3,786	29.6
South East Coast Ambulance Service NHS Foundation Trust	29.6	2,867	29.6
West Midlands Ambulance Service NHS Trust	28.7	4,100	28.7
North East Ambulance Service NHS Trust	26.7	1,638	26.7
South Western Ambulance Service NHS Foundation Trust	25.0	3,739	25.0
East of England Ambulance Service NHS Trust	24.1	3,441	24.1
Isle of Wight NHS PCT	22.8	127	22.8
Yorkshire Ambulance Service NHS Trust	22.6	2,973	22.6
East Midlands Ambulance Service NHS Trust	19.2	2,770	19.2
		Mean	**27.3**

Return of spontaneous circulation (ROSC) at time of arrival at hospital (Utstein Comparator Group)

		Incidents	Performance (%)
North East Ambulance Service NHS Trust	59.6	198	59.6
London Ambulance Service NHS Trust	55.1	539	55.1
South East Coast Ambulance Service NHS Foundation Trust	54.5	402	54.5
Yorkshire Ambulance Service NHS Trust	52.0	333	52.0
East of England Ambulance Service NHS Trust	50.0	332	50.0
South Central Ambulance Service NHS Trust	50.0	412	50.0
North West Ambulance Service NHS Trust	47.7	461	47.7
West Midlands Ambulance Service NHS Trust	45.6	485	45.6
South Western Ambulance Service NHS Foundation Trust	45.1	572	45.1
Isle of Wight NHS PCT	37.0	27	37.0
East Midlands Ambulance Service NHS Trust	35.8	316	35.8
		Mean	**49.1**

Survival to discharge (Overall)

	Incidents	Performance (%)
South Central Ambulance Service NHS Trust	1,433	16.7
Yorkshire Ambulance Service NHS Trust	2,742	10.6
South Western Ambulance Service NHS Foundation Trust	3,722	9.7
North West Ambulance Service NHS Trust	3,453	9.3
London Ambulance Service NHS Trust	4,597	9.0
South East Coast Ambulance Service NHS Foundation Trust	2,728	8.5
West Midlands Ambulance Service NHS Trust	4,100	8.3
East of England Ambulance Service NHS Trust	3,346	6.5
Isle of Wight NHS PCT	127	5.5
East Midlands Ambulance Service NHS Trust	2,608	4.9
North East Ambulance Service NHS Trust	1,550	4.8
Mean		**8.6**

Survival to discharge (Utstein Comparator Group)

	Incidents	Performance (%)
Yorkshire Ambulance Service NHS Trust	301	40.9
London Ambulance Service NHS Trust	518	31.5
South Central Ambulance Service NHS Trust	399	29.6
South Western Ambulance Service NHS Foundation Trust	567	27.7
North East Ambulance Service NHS Trust	166	26.5
South East Coast Ambulance Service NHS Foundation Trust	376	26.1
North West Ambulance Service NHS Trust	395	22.8
Isle of Wight NHS PCT	27	22.2
East of England Ambulance Service NHS Trust	310	20.6
West Midlands Ambulance Service NHS Trust	485	20.6
East Midlands Ambulance Service NHS Trust	277	15.5
Mean		**26.3**

Appendix 2: Response times and patient outcomes per Complex

Cluster	Complex	Number of patients	Median times (mins)			ROSC sustained to hospital		Resuscitation attempted survival[+]		Utstein survival[+#]	
			999 call - scene	999 call - CPR^	999 call – Defibrillation[#]						
North West	Hillingdon	197	07:53	08:57	12:04	34.0%	(67)	12.2%	(24/196)	37.9%	(11/29)
	Kenton	212	07:29	09:08	13:15	35.8%	(76)	8.1%	(17/211)	33.3%	(7/21)
	Brent	239	08:08	09:51	12:53	29.3%	(70)	8.4%	(20/238)	43.3%	(13/30)
West	Hanwell	172	07:11	09:01	12:06	33.1%	(57)	10.5%	(18/171)	22.2%	(6/27)
	Isleworth	162	07:28	08:33	12:54	27.2%	(44)	9.0%	(14/156)	36.8%	(7/19)
	Fulham	176	07:44	09:48	12:52	32.4%	(57)	10.3%	(18/175)	45.5%	(10/22)
North Central	Friern Barnet	157	07:46	09:58	12:52	33.8%	(53)	8.3%	(13/157)	28.6%	(6/21)
	Chase Farm	99	07:35	09:27	13:07	35.4%	(35)	9.2%	(9/98)	33.3%	(5/15)
	Edmonton	257	07:58	10:04	13:57	29.6%	(76)	7.5%	(19/254)	22.7%	(5/22)
	Camden	212	07:10	08:56	11:58	27.4%	(58)	11.5%	(24/209)	48.0%	(12/25)
East Central	City & Hackney	195	07:40	08:32	10:41	39.0%	(76)	12.5%	(24/192)	47.8%	(11/23)
	Newham	153	07:32	09:05	13:00	32.7%	(50)	7.3%	(11/150)	16.7%	(2/12)
	Tower Hamlets	120	08:12	09:36	14:06	22.5%	(27)	5.1%	(6/118)	14.3%	(2/14)
	Whipps Cross	331	07:46	09:05	12:06	33.5%	(111)	9.6%	(31/324)	29.0%	(9/31)
North East	Romford	237	07:05	08:21	11:08	32.1%	(76)	5.3%	(12/225)	4.2%	(1/24)
South East	Greenwich	231	07:58	09:23	15:28	29.4%	(68)	5.7%	(13/227)	26.3%	(5/19)
	Bromley	202	08:02	09:04	12:27	32.3%	(65)	10.5%	(21/200)	46.7%	(7/15)
	Barnehurst	192	07:16	08:52	14:22	29.2%	(56)	5.8%	(11/191)	10.0%	(2/20)
	Deptford	266	07:03	08:51	13:03	32.0%	(85)	13.8%	(36/261)	45.0%	(18/40)
South West	New Malden	150	07:23	08:58	11:22	43.3%	(65)	11.6%	(17/147)	30.0%	(6/20)
	St Helier	217	07:48	09:03	12:46	24.9%	(54)	5.6%	(12/215)	27.3%	(6/22)
	Wimbledon	168	07:36	09:02	12:52	35.9%	(60)	12.7%	(21/166)	47.1%	(8/17)
	Croydon	207	07:58	09:11	12:11	24.6%	(51)	7.4%	(15/203)	16.7%	(3/18)

^ Figures exclude arrests witnessed by LAS staff.
[#] Figures are based on patients with an initial rhythm of VF/VT and exclude arrests witnessed by LAS staff.
+ Denominators exclude patients with unknown survival outcomes.
 # Please view with caution due to small numbers.

Appendix 3: Survival per Hospital

Hospital	2012/13			2013/14			2014/15		
	Number of Patients	Survival with ROSC sustained to hospital+		Number of Patients	Survival with ROSC sustained to hospital+		Number of Patients	Survival with ROSC sustained to hospital+	
Barnet	60	10.0%	(2/20)	58	24.2%	(8/33)	77	21.4%	(6/28)
Central Middlesex	20	0.0%	(0/6)	21	0.0%	(0/1)	4	0.0%	(0/1)
Charing Cross	46	33.3%	(9/27)	43	47.1%	(8/17)	31	7.7%	(1/13)
Chelsea & Westminster	24	17.6%	(3/17)	40	25.0%	(4/16)	35	25.0%	(4/16)
Croydon	117	14.3%	(7/49)	104	6.1%	(2/33)	106	5.6%	(2/36)
Darent Valley	17	33.3%	(2/6)	15	16.7%	(1/6)	12	14.3%	(1/7)
Ealing	63	3.8%	(1/26)	76	18.5%	(5/27)	66	9.7%	(3/31)
Hammersmith	113	40.5%	(32/79)	119	49.4%	(40/81)	94	38.7%	(29/75)
Harefield	41	40.5%	(15/37)	36	40.0%	(12/30)	61	58.8%	(30/51)
Hillingdon	84	33.3%	(14/42)	82	29.7%	(11/37)	100	25.0%	(10/40)
Homerton	59	23.1%	(6/26)	35	10.0%	(1/10)	48	13.6%	(3/22)
King's College	180	32.0%	(32/100)	181	51.1%	(46/90)	192	40.7%	(44/108)
King George	61	6.5%	(2/31)	69	16.7%	(5/30)	75	16.2%	(6/37)
Kingston	63	9.5%	(4/42)	63	4.0%	(1/25)	58	16.7%	(3/18)
London Chest	87	45.8%	(33/72)	107	47.3%	(43/91)	124	56.5%	(61/108)
Newham	88	14.8%	(4/27)	81	11.1%	(2/18)	114	16.7%	(6/36)
North Middlesex	89	18.9%	(10/53)	107	14.3%	(6/42)	149	9.8%	(6/61)
Northwick Park	152	7.7%	(5/65)	127	9.3%	(4/43)	120	9.8%	(5/51)
Princess Royal	64	19.4%	(6/31)	87	31.4%	(11/35)	87	9.8%	(4/41)
Queen Elizabeth	121	34.5%	(20/58)	133	29.6%	(16/54)	150	12.5%	(7/56)
Queen's	166	14.9%	(7/47)	146	12.3%	(7/57)	150	6.0%	(3/50)
Royal Free	115	45.2%	(33/73)	129	38.8%	(31/80)	110	41.2%	(28/68)
Royal London	98	30.8%	(12/39)	100	20.0%	(8/40)	122	20.0%	(12/60)
St George's	171	37.9%	(36/95)	188	42.6%	(46/108)	200	38.7%	(46/119)
St Helier	59	4.3%	(1/23)	59	9.1%	(2/22)	78	17.2%	(5/29)
St Mary's	68	11.1%	(3/27)	73	32.0%	(8/25)	81	30.0%	(9/30)
St Thomas'	89	40.0%	(16/40)	97	42.0%	(21/50)	114	39.0%	(23/59)
The Heart	21	72.2%	(13/18)	24	70.0%	(14/20)	17	66.7%	(10/15)
University College Hospital	62	28.6%	(6/21)	51	42.1%	(8/19)	44	27.3%	(6/22)
Lewisham	100	26.7%	(8/30)	79	20.8%	(5/24)	80	19.0%	(4/21)
West Middlesex	91	25.0%	(9/36)	85	29.0%	(9/31)	79	23.5%	(8/34)
Whipps Cross	98	7.3%	(3/41)	106	21.2%	(11/52)	112	13.2%	(5/38)
Whittington	70	31.0%	(9/29)	51	19.2%	(5/26)	45	24.0%	(6/25)
Other Hospitals	3	-	-	9	50.0%	(2/4)	10	33.3%	(1/3)

+ Denominators exclude patients with unknown survival outcomes.

Appendix 4: Rhythm and survival per Heart Attack Centre for resuscitated patients with a STEMI

Heart Attack Centre	Number of Patients	Initial Rhythm			Survival to discharge+
		Asystole	VF/VT	PEA	
Hammersmith*	52	7.7% (4)	71.2% (37)	17.3% (9)	46.01% (23/50)
Harefield	53	18.9% (10)	67.9% (36)	13.2% (7)	49.1% (26/53)
King's College*	50	20.0% (10)	66.0% (33)	12.0% (6)	48.9% (23/47)
London Chest	91	19.8% (18)	70.3% (64)	9.9% (9)	57.1% (52/91)
Royal Free	40	20.0% (8)	62.5% (25)	17.5% (7)	34.2% (13/38)
St George's	48	20.8% (10)	70.8% (34)	8.3% (4)	45.7% (21/46)
St Thomas'	12	8.3% (1)	75.0% (9)	16.7% (2)	60.0% (6/10)
The Heart	16	25.0% (4)	62.5% (10)	12.5% (2)	62.5% (10/16)

* 3 patients had no initial rhythm documented; 2 taken to Hammersmith and 1 to King's College.
+ Denominators exclude patients with unknown survival outcomes.

Appendix 5: Patient characteristics, response times, and outcomes per Clinical Commissioning Group

Incident CCG	Number of Patients	Age	Male %		Median 999 Call – Scene	Bystander CPR*		Presumed cardiac		Shockable Initial Rhythm		ROSC sustained to hospital		Survived to discharge+	
Barking & Dagenham	128	64	54.7%	(70)	07:46	56.9%	(58/102)	90.6%	(116)	20.3%	(26)	34.4%	(44)	3.3%	(4/122)
Barnet	204	69	60.8%	(124)	08:17	66.3%	(116/175)	87.3%	(178)	18.6%	(38)	27.0%	(55)	5.4%	(11/204)
Bexley	149	72	61.7%	(92)	07:03	59.7%	(71/119)	88.6%	(132)	18.8%	(28)	27.5%	(41)	5.4%	(8/149)
Brent	173	66	61.3%	(106)	07:13	53.1%	(76/143)	89.0%	(154)	16.8%	(29)	28.3%	(49)	7.0%	(12/172)
Bromley	202	70	63.4%	(128)	08:18	62.6%	(102/163)	88.6%	(179)	18.3%	(37)	33.2%	(67)	9.0%	(18/200)
Camden	101	65	66.3%	(67)	07:00	60.9%	(53/87)	88.1%	(89)	25.7%	(26)	35.6%	(36)	13.0%	(13/100)
Central London	113	64	74.3%	(84)	06:57	72.6%	(69/95)	84.1%	(95)	23.0%	(26)	31.0%	(35)	13.4%	(15/112)
City & Hackney	155	64	61.3%	(95)	07:31	68.5%	(85/124)	81.9%	(127)	17.4%	(27)	33.5%	(52)	9.9%	(15/152)
Croydon	206	68	58.7%	(121)	08:00	65.0%	(104/160)	90.3%	(186)	18.9%	(39)	27.7%	(57)	7.0%	(14/200)
Ealing	188	68	67.0%	(126)	08:06	64.7%	(97/150)	89.9%	(169)	19.7%	(37)	33.0%	(62)	10.2%	(19/186)
Enfield	190	64	63.7%	(121)	07:50	69.0%	(109/158)	82.1%	(156)	15.3%	(29)	33.7%	(64)	9.5%	(18/190)
Greenwich	154	63	63.0%	(97)	07:27	62.3%	(76/122)	84.4%	(130)	18.8%	(29)	29.2%	(45)	6.0%	(9/151)
Hammersmith & Fulham	85	68	69.4%	(59)	07:29	67.6%	(48/71)	85.9%	(73)	18.8%	(16)	34.1%	(29)	8.3%	(7/84)
Haringey	139	61	62.6%	(87)	08:03	58.5%	(69/118)	77.7%	(108)	19.4%	(27)	31.7%	(44)	8.0%	(11/137)
Harrow	129	72	61.2%	(79)	08:12	59.8%	(67/112)	95.3%	(123)	14.7%	(19)	33.3%	(43)	8.6%	(11/128)
Havering	163	71	63.2%	(103)	07:24	60.8%	(79/130)	92.0%	(150)	12.9%	(21)	32.5%	(53)	4.7%	(7/150)
Hillingdon	216	67	62.5%	(135)	07:50	70.9%	(129/182)	90.3%	(195)	25.5%	(55)	35.6%	(77)	12.1%	(26/214)
Hounslow	137	69	64.2%	(88)	07:41	58.4%	(66/113)	86.1%	(118)	19.0%	(26)	29.9%	(41)	10.3%	(14/136)
Islington	106	59	63.2%	(67)	07:29	62.9%	(56/89)	73.6%	(78)	17.9%	(19)	37.7%	(40)	14.3%	(15/105)
Kingston	76	65	67.1%	(51)	06:42	67.2%	(45/67)	85.5%	(65)	26.3%	(20)	38.2%	(29)	12.2%	(9/74)
Lambeth	165	63	63.6%	(105)	07:06	60.3%	(79/131)	77.6%	(128)	17.6%	(29)	38.2%	(63)	10.4%	(17/164)
Lewisham	146	64	60.3%	(88)	08:05	58.8%	(70/119)	79.5%	(116)	14.4%	(21)	23.2%	(34)	7.6%	(11/145)
Merton	100	67	61.0%	(61)	07:24	66.7%	(52/78)	90.0%	(90)	21.0%	(21)	31.0%	(31)	13.1%	(13/99)
Newham	186	63	60.8%	(113)	07:19	65.4%	(100/153)	89.8%	(167)	18.3%	(34)	30.6%	(57)	9.8%	(18/183)
Redbridge	180	69	60.0%	(108)	07:26	65.2%	(103/158)	84.4%	(152)	17.8%	(32)	35.6%	(64)	11.9%	(21/177)
Richmond	84	72	75.0%	(63)	08:04	69.8%	(44/63)	88.1%	(74)	25.0%	(21)	32.1%	(27)	8.9%	(7/79)
Southwark	136	60	61.0%	(83)	07:08	59.1%	(68/115)	81.6%	(111)	16.2%	(22)	27.2%	(37)	12.6%	(17/135)
Sutton	126	67	62.7%	(79)	07:31	59.4%	(57/96)	87.3%	(110)	15.9%	(20)	30.2%	(38)	6.3%	(8/126)
Tower Hamlets	116	62	69.8%	(81)	07:46	62.3%	(66/106)	75.9%	(88)	17.2%	(20)	25.0%	(29)	6.9%	(8/116)
Waltham Forest	167	65	59.9%	(100)	08:09	60.7%	(85/140)	87.4%	(146)	16.2%	(27)	28.1%	(47)	7.4%	(12/163)
Wandsworth	129	66	61.2%	(79)	07:17	61.8%	(68/110)	85.3%	(110)	19.4%	(25)	28.7%	(37)	11.7%	(15/128)
West London	105	63	61.0%	(64)	07:14	60.9%	(53/87)	81.0%	(85)	21.0%	(22)	33.3%	(35)	10.5%	(11/105)
Out of London	6	69	83.3%	(5)	12:57	80.0%	(4/5)	83.3%	(5)	50.0%	(3)	16.7%	(1)	0.0%	(0/6)

** Figures exclude arrests witnessed by LAS staff.*
+ Denominators exclude patients with unknown survival outcomes.

Appendix 6: Cardiac arrest patients under 35 years old

	Under 1	1-8	9-18	19-35
Number of patients:	64	42	41	251
Gender:				
Male	53.1% (34)	54.8% (23)	73.2% (30)	70.5% (177)
Female	45.3% (29)	45.2% (19)	26.8% (11)	29.5% (74)
Unknown	1.6% (1)	-	-	-
Arrest location:				
Private	89.1% (57)	78.6% (33)	58.5% (24)	56.6% (142)
Public	10.9% (7)	21.4% (9)	41.5% (17)	43.4% (109)
Witnessed◊:				
Bystander	28.1% (18)	31.0% (13)	43.9% (18)	39.0% (98)
LAS staff	10.9% (7)	11.9% (5)	17.1% (7)	14.7% (37)
Unwitnessed	60.9% (39)	54.8% (23)	39.0% (16)	45.8% (115)
Not Documented	-	2.3% (1)	-	0.4% (1)
Bystander CPR*:				
Yes	63.2% (36/57)	59.5% (22/37)	70.6% (24/34)	70.1% (150/214)
No	36.8% (21/57)	40.5% (15/37)	29.4% (10/34)	29.9% (64/214)
Rhythm:				
Asystole	64.1% (41)	69.0% (29)	61.0% (25)	59.8%(150)
PEA	10.9% (7)	23.8% (10)	17.1% (7)	19.1% (48)
VF/ Pulseless VT	1.6% (1)	2.4% (1)	14.6% (6)	19.9% (50)
Not Documented	23.4% (15)	4.8% (2)	7.3% (3)	1.2% (3)
ROSC sustained to hospital:				
Yes	14.1% (9)	19.0% (8)	19.5% (8)	30.7% (77)
No	85.9% (55)	81.0% (34)	80.5% (33)	69.3% (174)
Survived to discharge+:				
Yes	6.8% (4/59)	12.5% (5/40)	10.0% (4/40)	15.0% (37/247)
No	93.2% (55/59)	87.5% (35/40)	90.0% (36/40)	85.0% (210/247)

◊ Totals for Under 1 and 19-35 year olds do not equal 100% due to rounding.
** Figures exclude arrests witnessed by LAS staff.*
+ Denominators exclude patients with unknown survival outcomes.