London Ambulance Service
NHS Trust

Cardiac Arrest Annual Report: 2017/18

November 2018

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Patients

10,654 Total number

4,389 Resuscitation attempted

64% 62 years

36% 68 years

Bystander witnessed | LAS witnessed | Unwitnessed

Bystander CPR | No bystander CPR

Outcomes

32.5% Overall ROSC to hospital

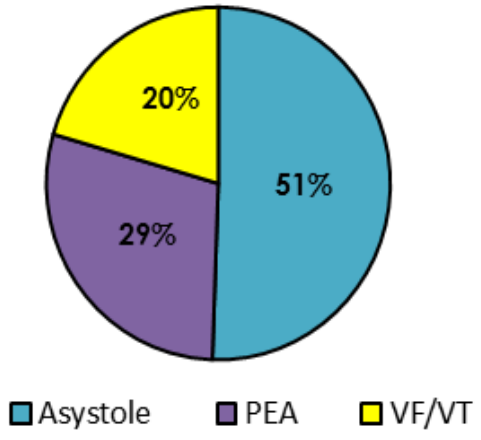
9.4% Overall survival

56.6% Utstein ROSC to hospital

31.9% Utstein survival

Response

Initial rhythm



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1. Introduction

From 1st April 2017 to 31st March 2018, the London Ambulance Service NHS Trust (LAS) attended **10,654** patients who had suffered an out-of-hospital cardiac arrest. Our clinicians attempted to resuscitate **4,389** (**41.2**%) of these patients. Resuscitation efforts were not undertaken for **6,265** (**58.8**%) patients: 4,665 (74%) were recognised as deceased on arrival of the clinician, and for a further 1,600 (26%) a Do Not Attempt Cardio-Pulmonary Resuscitation (DNA-CPR) order, advanced directive or similar equivalent was in place, or the patient's death was expected.

Data were 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), emergency call logs and defibrillator data. Survival to hospital discharge information is collected from hospital patient records and national databases.

This report presents information regarding the clinical care provided and the outcomes of the **4,389** patients where resuscitation was attempted.

2. Profile of arrests

Gender □, n (%)	
Male	2,808 (64.0)
Female	1,578 (36.0)
Unknown	3 (0.1)

Age, mean (median) in years	
Overall	65 (69)
Male	62 (66)
Female	68 (74)

Race, n (%)	
White	2,570 (58.6)
Asian	377 (8.6)
Black	344 (7.8)
Mixed	36 (0.8)
Other	195 (4.4)
Unable to obtain	811 (18.5)
Not documented	56 (1.3)

Peak occurrence	
Time of day (hh:mm)	08:00-11:59 22.3% (n=977)
Day	Saturday 14.9% (n=655)
Month	December 10.4% (n=458)

Response times, median in minutes	
999 call – scene	07:26
999 call – LAS CPR*	09:18
999 call – LAS defibrillation*~	10:41

Location □, n (%)	
Private location	**3,272 (74.5)**
Home	3,027 (92.5)
Care home	245 (7.5)
Public location	**1,117 (25.4)**
Street	526 (47.1)
Work	94 (8.4)
Healthcare facility	150 (13.4)
Public transport	61 (5.5)
Social venue	57 (5.1)
Shop/bank	37 (3.3)
Park/wood/river	30 (2.7)
Hotel/Hostel	34 (3.0)
Leisure centre/sports club	37 (3.3)
Airport	24 (2.1)
Other	67 (6.0)

Chief complaints at the 999 call, n (%)□	
Cardiac arrest	2,418 (55.1)
Unconscious/fainting	546 (12.4)
Breathing problems	387 (8.8)
Falls	137 (3.1)
Other	801 (18.3)
111 NHS Transfers	63 (1.4)
HCP Admissions	37 (0.8)

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

** Excludes LAS witnessed arrests.*

~ Based on an initial rhythm of VF/VT.

Table 1: Profile of cardiac arrests where resuscitation was attempted (n=4,389)

3. Response information

On 1st November 2017, the LAS implemented the new national ambulance standard for call categorisation and response times as defined by NHS England's Ambulance Response Programme (ARP). As the implementation of the new standards redefined the response categories and the way response times are measured, this section is sub-divided into two parts reporting LAS performance against the previous definitions (pre-ARP) and the new standards (post-ARP).

3.1. 1st April 2017 – 31st October 2017 (Pre-ARP)

During this period, calls were categorised as Red or Green calls. The highest priority (Red) response category was sub-divided into Red 1 and Red 2 (with Red 1 indicating those incidents which were immediately life-threatening). Red 1 responses were measured from the time the call was connected by the operator. The remaining categories allowed a period of time for information gathering by the EMD in order to assign the most appropriate response to each patient. For all categories, the clock stopped when the first resource arrived on scene. Red calls had a national target of 75% of patients receiving a response within 8 minutes.

Category	n (%)	Response time, mins		
		Mean	Median	90th Centile
Red 1	1,536 (66.7)	7	7	11
Red 2	608 (26.4)	7	6	13
Green	159 (6.9)	20	12	45
Overall*	**2,303**	**8**	**7**	**12**

** Category not available for 1 case.*

Table 2: Pre-ARP response times by category

3.2. 1st November 2017 – 31st March 2018 (Post ARP)

From 1st November 2017, calls were categorised into four groups from Category 1 for 'life-threatening illnesses or injuries' such as cardiac arrest through to 'less urgent conditions' in Category 4. For each category, the response time is measured using a set of rules that define the point at which the clock starts and the type of resource that is required to arrive on scene for the clock to stop (see below).

Category	Response standard (mins)		Definitions
	Mean	90th centile	
Category 1 (Life threatening)	7	15	Clock start The earliest time that: • the call is assigned a chief complaint; or • the first resource is dispatched; or • 30 seconds from the call connecting. Clock stop The arrival of the first LAS resource (whether a solo responder or an ambulance).
Category 2 (Emergency)	18	40	Clock start The earliest time that: • the call is assigned a chief complaint; or • the first resource is dispatched; or • 240 seconds from call connect Clock stop The arrival of the first LAS vehicle able to transport the patient to hospital.
Category 3 (Urgent)	120 (maximum time)		
Category 4 (Less urgent)	180 (maximum time)		

A set of pre-triage questions are used to help early recognition of life-threatening conditions, such as cardiac arrest.This enables a rapid dispatch of a resource to Category 1 calls. For lower priority response categories, Emergency Medical Dispatchers (EMDs) have additional time to triage the call so that the most appropriate response for the patient's condition is assigned.

Category	n (%)	Response time, mins		
		Mean	Median	90th Centile
Category 1	1,519 (72.8)	7	6	11
Category 2	469 (22.5)	16	13	28
Category 3	81 (3.9)	24	15	60
Category 4	17 (0.8)	76	46	239
Overall	**2,086**	**10**	**7**	**18**

Table 3: Post-ARP response times by category

- From 1st April 2017 to 31st October 2018 (pre-ARP), two-thirds **(66.7%)** of patients received a **Red 1** response, with **26.4%** allocated to a **Red 2** category. The mean response was **7 minutes** for those patients allocated a **Red** call.
- From 1st November 2017 to 31st March 2018 (post-ARP), nearly three-quarters **(72.8%)** of patients received a **Category 1** response. The mean response was **7 minutes** for those patients allocated to **Category 1**.
- For **all** cardiac arrest patients the mean time taken for a response to arrive was **7 minutes** overall.

4. Clinical presentation

4.1. Aetiology

Aetiology	n (%)	ROSC sustained to hospital n (%)	Survival to discharge† n (%)
Presumed cardiac	3,340 (76.1)	1,100 (32.9)	348/3,276 (10.6)
Other medical	473 (10.8)	141 (29.8)	30/463 (6.5)
Trauma	207 (4.7)	34 (16.4)	5/199 (2.5)
Asphyxial	231 (5.3)	95 (41.1)	7/224 (3.1)
Overdose	119 (2.7)	52 (43.7)	11/112 (9.8)
Drowning	18 (0.4)	6 (33.3)	1/17 (5.9)
Electrocution	1 (0.0)	0 (0.0)	0/1 (0.0)

† *Denominators exclude patients with unknown survival outcomes (n=97).*

Table 4: Patient aetiology with ROSC and survival

- **Presumed cardiac aetiology** was the predominant cause of cardiac arrest (76.1%).
- Both **overdose** and **asphyxial** aetiologies resulted in higher ROSC sustained to hospital than other aetiologies (43.7% and 41.1% respectively)
- **Presumed cardiac aetiology** presented with the highest survival to discharge (10.6%) of all aetiologies.

4.2. Initial rhythm

LAS recorded initial rhythm*	n (%)□	Change^	ROSC sustained to hospital		Survival to discharge†	
			n (%)	Change^	n (%)	Change^
Asystole~	2,203 (50.1)	↑0.5%	465 (21.1)	↑4.4%	29/2,179 (1.3)	↓0.3%
PEA	1,259 (28.7)	↑0.8%	456 (36.2)	↑3.6%	79/1,220 (6.5)	↑1.2%
VF/VT	889 (20.3)	↓1.5%	484 (54.4)	↑0.4%	283/860 (32.9)	↓0.2%

** Not documented in 38 cases.*

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

^ *Increase or decrease in percentage from 2016/17.*

† *Denominator excludes patients with unknown survival outcomes (n=97).*

~ *Includes paediatric bradycardia (n=2).*

Table 5: Initial rhythm with ROSC and survival

- **Asystole (50.1%)** remains the predominant initial rhythm.
- **PEA** has increased slightly by 0.8% from 27.9% in 2016/17 to **28.7%** this year but has showed a large increase in ROSC sustained to hospital (3.6% from 32.6% in 2016/17) and are the only group to have an increase in survival to discharge (1.2% from 5.3%).
- The proportion of **VF/VT** has decreased by 1.5% to **20.3%** from 21.8% in 2016/17.

5. Bystander interventions

5.1. Bystander witnessed and CPR

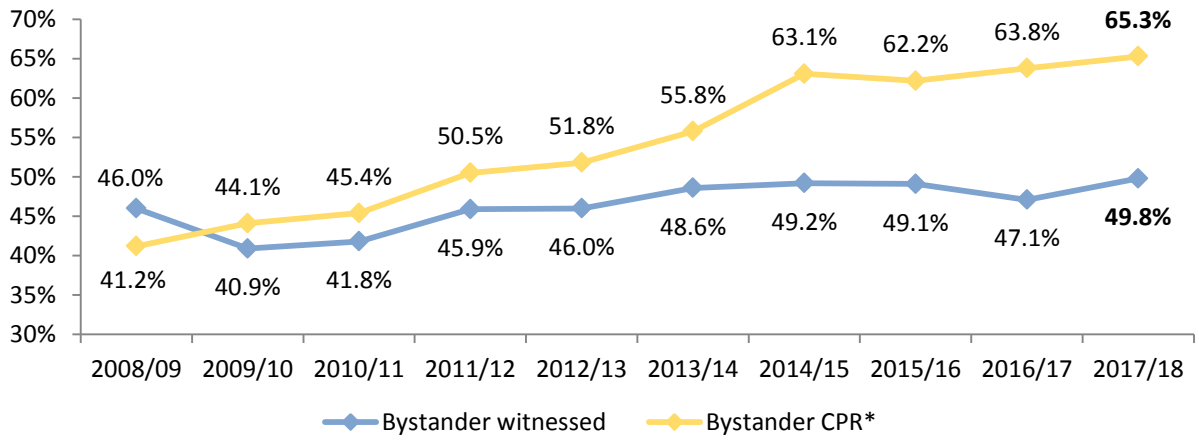


Figure 1: Bystander witnessed and CPR

**Excludes LAS witnessed arrests*

- **Both bystander witnessed** and bystander **CPR** rates are the **highest** observed over the last ten years.
- Nearly **half** (49.8%, n=2,186) of cardiac arrests where resuscitation was attempted were **bystander witnessed**.
- **65.3%** (n=2,431) of patients received **bystander CPR.**

5.2. Public Access Defibrillator (PAD)

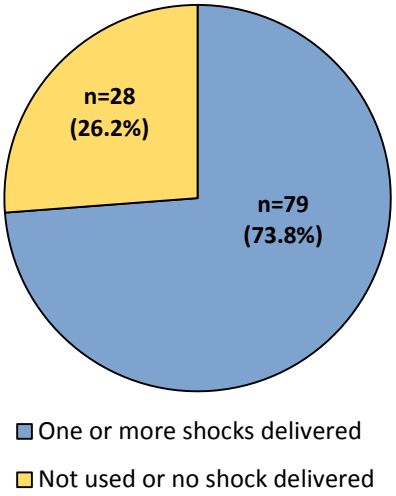


Figure 2: Deployment of a PAD

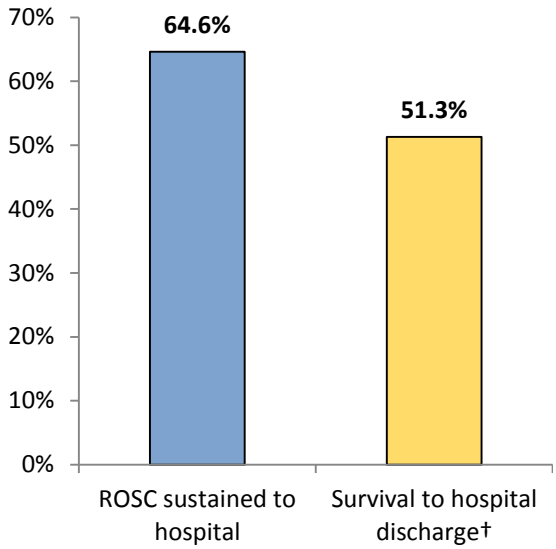


Figure 3: Outcomes post-PAD use

† *Excludes 3 patients with unknown outcomes.*

- A PAD was deployed for 107 cardiac arrests, with **one or more shocks** being delivered by members of the public in **79** cases.
- Of the 79 patients where a PAD was used to deliver a shock:
  - **94.9%** arrests (n=75) were **bystander witnessed**, which is a 1.9% increase compared with last year.
  - **All** patients received **bystander CPR**.
  - **64.6%** (n=51/79) had **ROSC** sustained to hospital (2.8% decrease from last year).
  - **Survival** to hospital discharge for these patients was **51.3%** (n=39/76), which is a marginal decrease of 0.5% compared to last year (51.8%).

6. Outcomes

6.1. Conveyance

Conveyance	n (%)
Conveyance to hospital	2,467 (56.2%)
Conveyed to an ED	1,921 (77.9%)
Conveyed to a HAC~	546 (22.1%)
Resuscitation terminated on-scene	1,922 (43.8%)

~ Includes all patients regardless of whether a STEMI was identified or if ROSC was obtained.

Table 6: Conveyance

- **More** patients (3.6%) were **conveyed** to hospital with either a Return of Spontaneous Circulation (ROSC) or ongoing CPR than last year.

6.2. ROSC and Survival

ROSC sustained to hospital arrival and survival to discharge figures are reported for two groups:

1. Overall group: all patients where resuscitation was attempted.

2. Utstein[1,2] comparator group: a sub-group of resuscitation attempted patients where the arrest was of a presumed cardiac cause, bystander witnessed, and in a shockable rhythm (VF/VT) on arrival of the LAS.

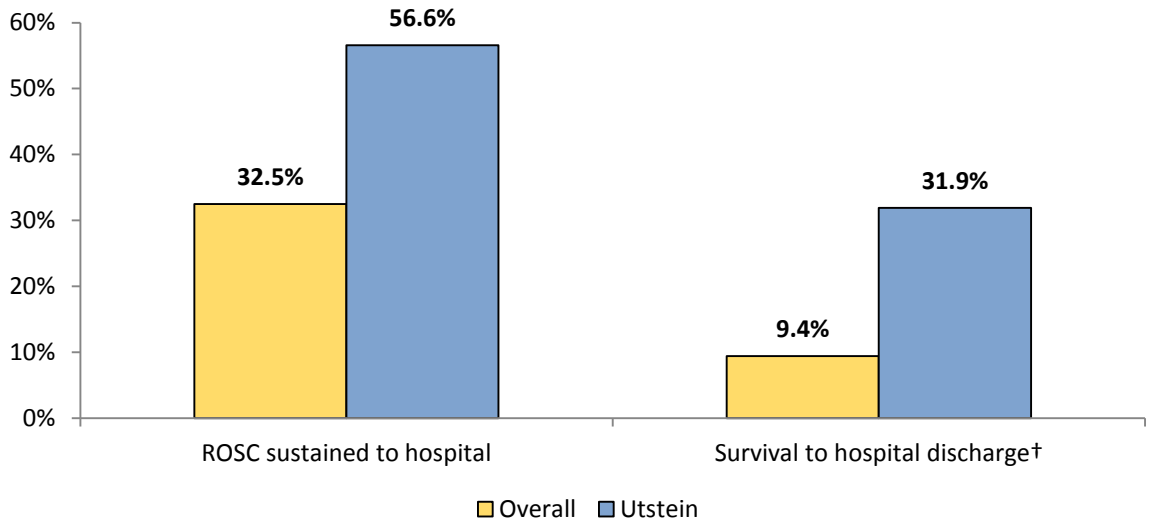


Figure 4: ROSC sustained to hospital and survival to hospital discharge for all resuscitation attempted patients ('overall') and the Utstein comparator group

† Excludes cases where the outcome was unknown from the overall (n=97) and Utstein (n=21) group

- The **overall ROSC** sustained to hospital rate was **32.5%** (n=1,428) - a 3.1% increase from last year and the highest ROSC rate achieved to date (see Figure 6).
- The **overall survival** to hospital discharge rate was **9.4%** (n=402/4,292), which is a very slight decrease (0.1%) from last year.
- For the **Utstein** comparator group, **ROSC** sustained to hospital arrival increased by 2.1% to **56.6%** (n=335/592).
- The **Utstein survival** rate of **31.9%** (n=182/571) is a 2.4% increase of from last year (see Figures 5 and 7).

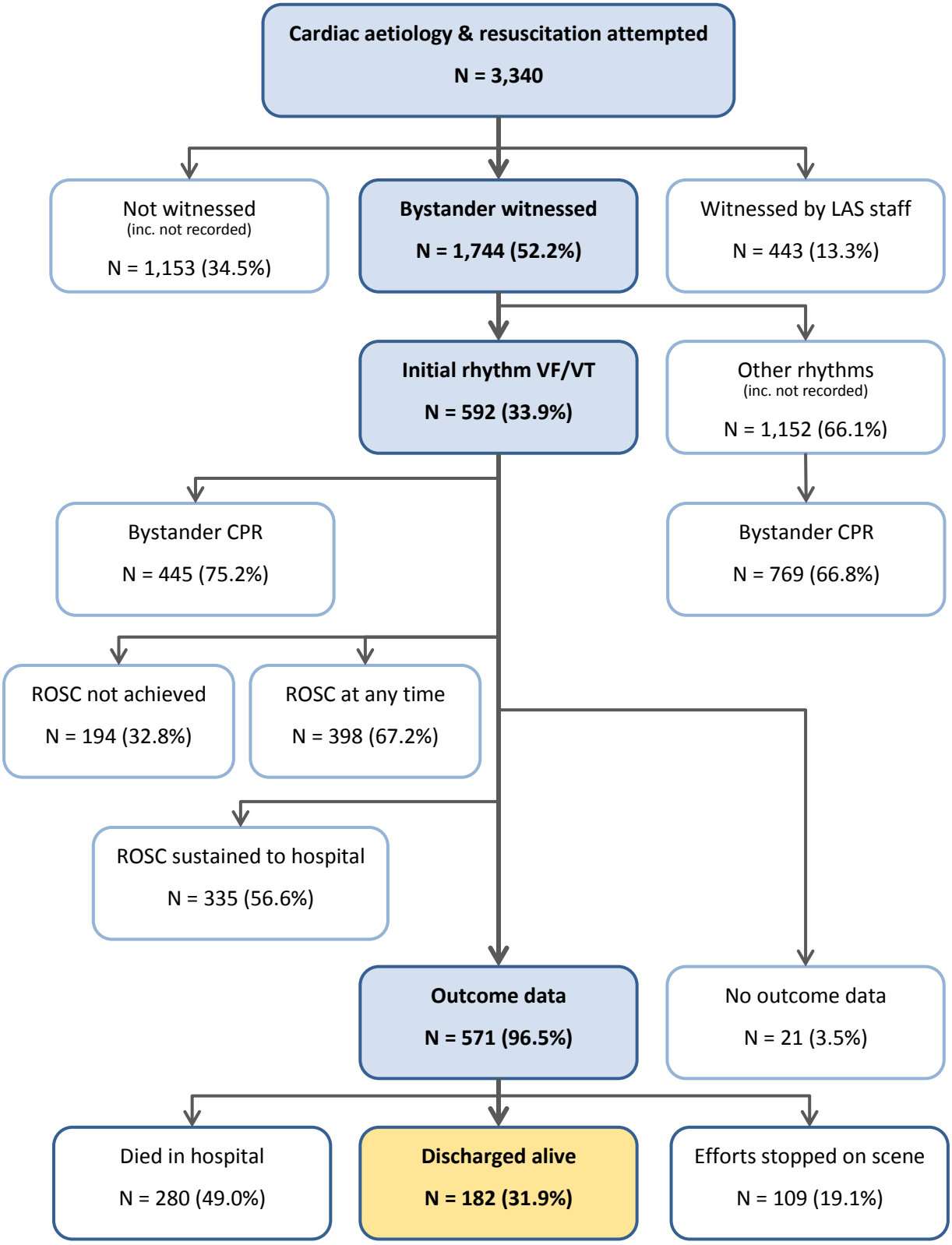


Figure 5: Outcomes for the Utstein comparator group

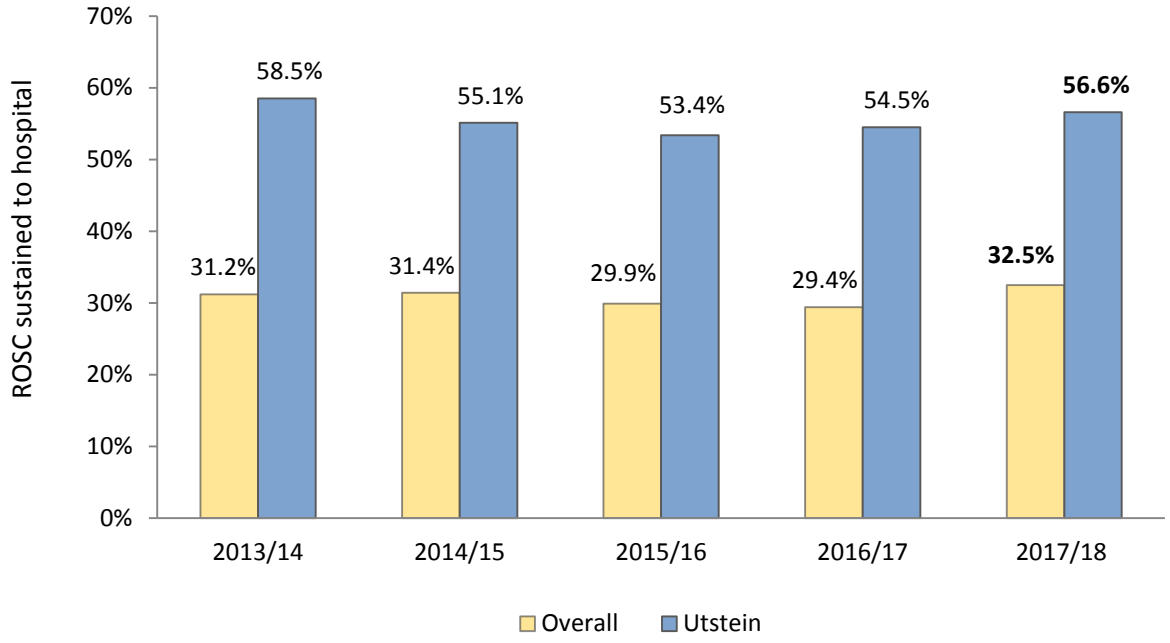


Figure 6: ROSC sustained to hospital per year for all resuscitation attempted patients ('overall') and the Utstein comparator group

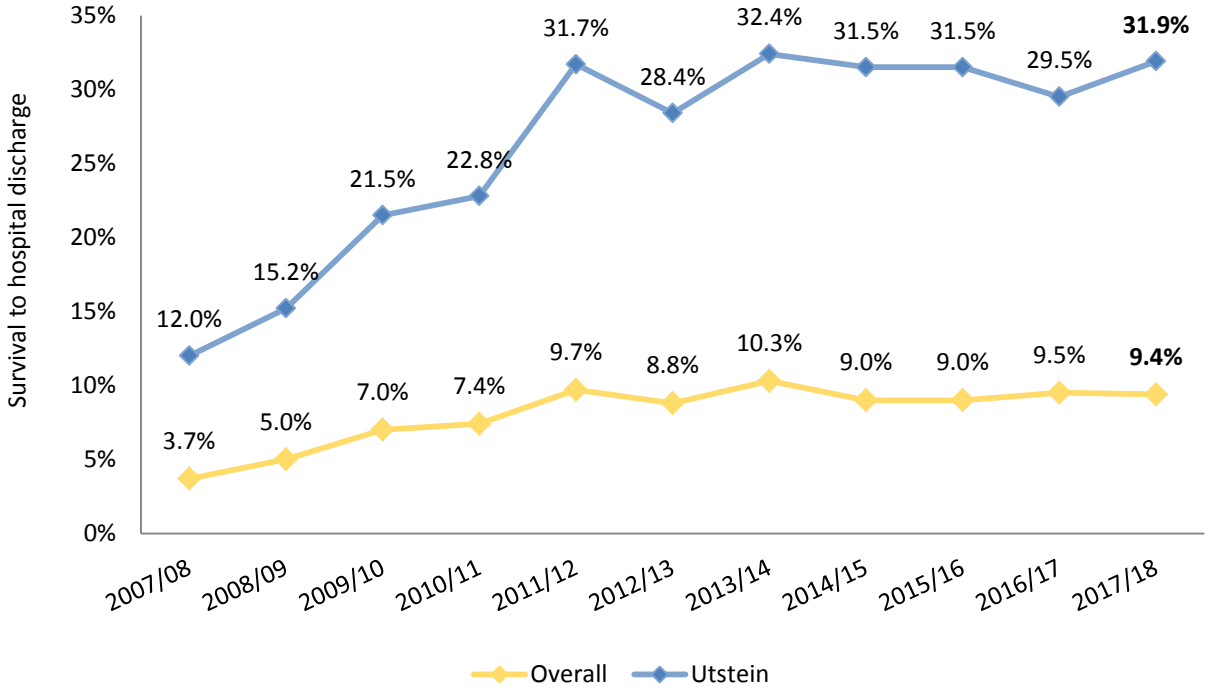
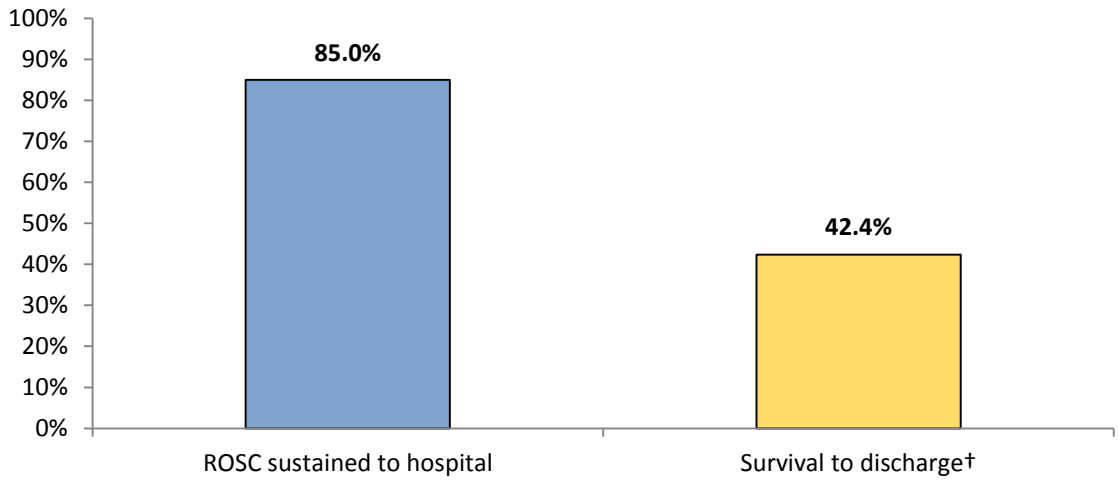


Figure 7: Survival to hospital discharge per year for all resuscitation attempted patients ('overall') and the Utstein comparator group

7. Resuscitated patients conveyed to a Heart Attack Centre (HAC) following a STEMI

Cardiac arrest patients who have a ST-elevation Myocardial Infarction (STEMI) and have achieved stable ROSC on-scene are conveyed to a HAC as part of a specialist pathway.



† Denominator excludes patients with unknown survival outcomes (n=17).

Figure 8: Outcomes of resuscitated patients conveyed to a HAC following a STEMI

- Of the 546 patients conveyed to a HAC, **420** patients had a suspected STEMI and, achieved ROSC and were transported to HAC following a cardiac arrest as part of the specialist pathway.
- The **majority** of these patients had an initial rhythm of **VF/VT** (67.9%, n=285) whilst asystole and PEA accounted for 16.4% (n=69) and 15.5% (n=65) of cases.
- **Survival** to hospital discharge for patients within this specialist pathway remains higher than other groups at **42.4%** (n=171/403)**,** but has decreased considerably by 8.3% from 50.7% in 2016/17.
- A breakdown of survival and initial rhythm for patients conveyed to specific London HACs can be found in Appendix 3.

8. Staff involvement

8.1. LAS witnessed arrests

LAS witnessed	n (%)*	ROSC sustained to hospital n (%)	Survival to discharge† n (%)
Asystole~	142 (21.4)	38 (26.8)	7/138 (5.1)
PEA	377 (56.7)	135 (35.8)	31/367 (8.4)
VF/VT	132 (19.8)	91 (68.9)	74/128 (57.8)
All patients	665 (15.2)	273 (41.1)	117/647 (18.1)

** Not documented in 14 cases.*

† Denominator excludes patients with unknown survival outcomes (n=18).

~ Includes paediatric bradycardia (n=2)

Table 7: Outcome of LAS witnessed arrests

- LAS clinicians witnessed **665** patients suffer a cardiac arrest.
- Overall, **ROSC** sustained to hospital **increased** by 2.6% from 2016/17. However, **survival** to discharge has **decreased** by 2.5%.
- Of note, compared to last year, less patients presented in an initial shockable rhythm (decrease of 3.5% to 19.8% in VF/VT) and more patients had PEA (up by 5.0% to 56.7%).

8.2. Advanced Paramedic Practitioners (APPs)

Advanced Paramedic Practitioners (APPs) manage resuscitation efforts and provide enhanced care to patients. APPs are dispatched to cardiac arrests either automatically or following a comprehensive triage by an APP based in the Emergency Operations Centre (EOC), who ensures APPs attend those who are most likely to benefit from advanced skills.

APP patient outcomes	n (%)	Change^
ROSC sustained to hospital	508 (39.7)	↑5.1%
Survival to discharge†	162 (13.1)	↑1.0%

† Denominator excludes patients with unknown survival outcomes (n=39).

^ Increase or decrease in percentage from 2016/17.

Table 8: APP skills and patient outcomes

- An **APP** was present and assumed primacy of care for **1,280** cases.
- **ROSC** sustained to hospital **(39.7%)** and **survival** to hospital discharge **(13.1%)** have increased from 2016/17 (30.7% and 12.1% respectively).
- In cases where an APP was present, ROSC and survival to discharge from hospital remained higher than the overall LAS figures. However, when an APP was in attendance, the rate of **VF/VT** was **29.6%**, which is 9.3% higher than the percentage reported for all resuscitation attempted patients.

9. Quality improvement activity

As part of our 5-year Clinical Strategy 2016-2021, we have committed to key initiatives to improve cardiac arrest survival. During 2017/18:

- We reviewed and updated our internal adult and paediatric cardiac guidelines including: clarity of when to attempt resuscitation, use of Automated External Defibrillation mode and instructions on how to use manual processes to ensure defibrillatory shocks are delivered as quickly as possible to VF/VT patients, amiodarone use after three defibrillator attempts, and manual uterine displacement in pregnant patients.

- The LAS has continued to provide educational updates to staff via Core Skills Refresher sessions, bulletins, and case studies in internal publications such as the Clinical Update and the learning from experience Insight magazine.

- We have in the past year improved defibrillator data availability to 14%, with a further target of 20% for 2018/19.

- During 2017/18, we supported public education and bystander interventions through:

    - Increasing the number of public access defibrillators in London to 4,972

    - Between 16th June – 30th October 2017, the Metropolitan Police co-responding initiative was rolled out across London with response cars equipped with defibrillators automatically dispatched to cardiac arrest calls

    - Community Resuscitation Training Officers delivering emergency life support training to over 6,000 members of the public

    - Ensuring that all volunteer LAS Emergency Responders are appropriately trained.

- During 2017/18, CARU sent out 1,260 letters to clinical staff who attended cardiac arrest patients, who survived to hospital discharge, in recognition of the lifesaving interventions provided at scene and en-route to hospital.

- Additionally, 315 letters were sent out to our Emergency Medical Dispatchers in appreciation of their crucial role in the early recognition of cardiac arrests and initiation of dispatcher assisted bystander CPR.

- Monthly care packs and $EtCO_2$ reports have been disseminated across the Trust to improve clinical care at a local level.

- The LAS recruited in total 2,102 patients to the Paramedic 2 trial – a randomised clinical trial investigating the effectiveness of adrenaline use during cardiac arrest and its impact on short and long-term patient outcomes. The trial was completed in October 2017 and the findings published in the New England Journal of Medicine[3].

10. Conclusion

This year, we have seen improvements in ROSC sustained to hospital for all patients where resuscitation was attempted and within the specific Utstein sub-group (32.5% and 56.6% respectively). The survival for the Utstein sub-group has increased to 31.9% (from 29.5% in 2016/17). However, the survival rate for the overall group has seen a marginal decrease of 0.1% to 9.4% in 2017/18.

Our improved ROSC sustained to hospital rates and Utstein survival rates reflect the ongoing efforts a wider system. Bystander witnessed and bystander CPR rates have increased to a 10 year high and are a commendable achievement by members of the public. The LAS has continued to provide a rapid response allowing for early interventions to successfully resuscitate patients prior to conveyance to hospital for ongoing treatment. It also reflects the contribution of London-wide hospitals and their ongoing treatment of patients in hospital.

11. Looking forward

In 2018/19, the LAS will progress a number of key objectives to improve patient care:

- A fundamental area for improvement is the downloading of defibrillator files with a target of 20% downloads set for 2018/19. The LAS will continue to pursue the technology and infrastructure to enable clinicians to download files directly from the defibrillators.

- The introduction of an Ambulance Quality Indicator (AQI) for post resuscitation patients to monitor the provision of care given to stabilise patients on-scene following ROSC. The AQI will focus on the recording of a 12 lead ECG, blood glucose, End-tidal Carbon Dioxide ($EtCO_2$) and blood pressure measurement, and delivery of oxygen and fluids.

- Continuing to increase our accredited defibrillator scheme and public education courses.

- With supportive findings from the ARREST pilot study[4], we have begun the roll out of a large-scale randomised clinical trial in collaboration with Guys & St Thomas' NHS Foundation Trust and King's College Hospital NHS Foundation Trust. We aim to fully determine the potential benefit of conveying all cardiac arrest patients, once ROSC is achieved on-scene, directly to a HAC.

12. References

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Glossary of abbreviations and terms

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

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

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

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

Defibrillators – The LAS use portable defibrillators to help diagnose the heart's rhythm and deliver a pre-set charged shock of 360J.

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.

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. $EtCO_2$ 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.

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.

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

Incident CCG*	Number of patients	Age (years)	Male % (n)		Median response^ (mins)	Bystander CPR# % (n)		Presumed cardiac % (n)		Shockable initial rhythm % (n)		ROSC sustained to hospital % (n)		Survived to discharge+ % (n)	
Barking & Dagenham	120	62	64.2%	(77)	07:23	70.7%	(70)	71.7%	(86)	16.7%	(20)	34.2%	(41)	9.5%	(11)
Barnet	188	68	64.4%	(121)	08:25	67.7%	(111)	83.5%	(157)	19.7%	(37)	28.7%	(54)	9.0%	(17)
Bexley	124	71	58.9%	(73)	07:56	65.7%	(67)	80.6%	(100)	24.2%	(30)	33.1%	(41)	6.8%	(8)
Brent	191	64	66.0%	(126)	07:42	60.6%	(103)	75.9%	(145)	24.6%	(47)	35.1%	(67)	9.1%	(17)
Bromley	158	66	61.4%	(97)	08:14	58.4%	(80)	85.4%	(135)	25.3%	(40)	34.2%	(54)	8.4%	(13)
Camden	114	60	71.1%	(81)	06:29	66.3%	(63)	71.9%	(82)	20.2%	(23)	36.0%	(41)	14.2%	(16)
Central London	121	62	73.6%	(89)	06:26	67.6%	(73)	74.4%	(90)	28.9%	(35)	33.1%	(40)	18.1%	(21)
City & Hackney	132	58	65.9%	(87)	07:11	67.5%	(79)	72.7%	(96)	21.2%	(28)	39.4%	(52)	13.3%	(17)
Croydon	186	67	58.6%	(109)	07:39	68.4%	(108)	73.1%	(136)	19.9%	(37)	31.2%	(58)	9.2%	(17)
Ealing	193	66	67.4%	(130)	07:20	66.1%	(113)	74.6%	(144)	16.6%	(32)	32.1%	(62)	7.8%	(15)
Enfield	180	64	63.9%	(115)	07:39	66.7%	(100)	78.3%	(141)	18.3%	(33)	26.7%	(48)	8.3%	(15)
Greenwich	133	61	54.9%	(73)	07:09	60.7%	(68)	74.4%	(99)	13.5%	(18)	31.6%	(42)	9.1%	(12)
Hammersmith & Fulham	81	66	69.1%	(56)	06:28	61.6%	(45)	69.1%	(56)	21.0%	(17)	28.4%	(23)	13.7%	(10)
Haringey	127	64	63.0%	(80)	07:09	61.5%	(64)	72.4%	(92)	18.9%	(24)	31.5%	(40)	6.4%	(8)
Harrow	124	66	58.1%	(72)	07:24	61.2%	(60)	84.7%	(105)	23.4%	(29)	34.7%	(43)	8.9%	(11)
Havering	145	69	64.8%	(94)	07:40	62.2%	(69)	79.3%	(115)	19.3%	(28)	27.6%	(40)	6.3%	(9)
Hillingdon	203	68	61.6%	(125)	07:52	73.3%	(118)	75.9%	(154)	23.6%	(48)	33.0%	(67)	11.9%	(24)
Hounslow	143	66	67.8%	(97)	07:00	66.1%	(80)	74.1%	(106)	18.9%	(27)	32.9%	(47)	8.1%	(11)
Islington	102	61	68.6%	(70)	07:24	58.6%	(51)	65.7%	(67)	20.6%	(21)	27.5%	(28)	7.8%	(8)
Kingston	70	70	65.7%	(46)	07:28	61.7%	(37)	75.7%	(53)	15.7%	(11)	40.0%	(28)	5.8%	(4)
Lambeth	155	62	61.9%	(96)	06:47	56.6%	(77)	74.2%	(115)	17.4%	(27)	35.5%	(55)	7.4%	(11)
Lewisham	137	62	61.3%	(84)	07:01	54.5%	(60)	70.8%	(97)	14.6%	(20)	34.3%	(47)	8.9%	(12)
Merton	98	68	59.2%	(58)	07:22	57.1%	(48)	79.6%	(78)	14.3%	(14)	32.7%	(32)	6.2%	(6)
Newham	169	60	59.8%	(101)	07:19	69.9%	(100)	74.6%	(126)	15.4%	(26)	26.6%	(45)	4.8%	(8)
Redbridge	156	71	66.7%	(104)	07:30	81.2%	(108)	80.8%	(126)	20.5%	(32)	37.8%	(59)	7.9%	(12)
Richmond	93	71	64.5%	(60)	07:15	64.6%	(51)	81.7%	(76)	22.6%	(21)	30.1%	(28)	6.8%	(6)
Southwark	173	60	70.5%	(122)	07:22	64.6%	(95)	73.4%	(127)	20.8%	(36)	32.4%	(56)	12.5%	(21)
Sutton	99	70	62.6%	(62)	07:04	62.9%	(56)	83.8%	(83)	16.2%	(16)	38.4%	(38)	12.2%	(12)
Tower Hamlets	111	57	67.6%	(75)	07:24	67.0%	(67)	74.8%	(83)	26.1%	(29)	31.5%	(35)	11.0%	(12)
Waltham Forest	117	63	64.1%	(75)	08:05	74.1%	(65)	77.8%	(91)	24.8%	(29)	26.5%	(31)	9.0%	(10)
Wandsworth	135	64	57.8%	(78)	07:08	72.2%	(83)	76.3%	(103)	24.4%	(33)	39.3%	(53)	11.3%	(15)
West London	101	63	67.3%	(68)	07:39	60.7%	(54)	67.3%	(68)	18.8%	(19)	29.7%	(30)	12.4%	(12)

** Patients conveyed to non-London CCGs (n=7) and where CCG was missing (n=3) are excluded from the table. # Figures exclude arrests witnessed by LAS staff.*
^Overall response times are measured from the time the call was connected by the operator. + Denominators exclude patients with unknown survival outcomes.

Appendix 2: Patients with ROSC sustained to hospital who survived to discharge

Hospital name	2015/16*			2016/17			2017/18		
	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	42	25.0%	(3/12)	41	12.5%	(2/16)	50	26.1%	(6/23)
Barts Health^	124	53.5%	(54/101)	133	57.8%	(67/116)	125	55.8%	(53/95)
Charing Cross	40	18.2%	(4/22)	31	21.4%	(3/14)	34	9.1%	(1/11)
Chelsea & Westminster	33	35.7%	(5/14)	19	25.0%	(2/8)	33	27.8%	(5/18)
Croydon	123	10.4%	(5/48)	87	15.8%	(6/38)	69	14.7%	(5/34)
Darent Valley	10	50.0%	(2/4)	15	20.0%	(1/5)	11	0%	(0/4)
Ealing	54	12.5%	(3/24)	44	18.8%	(3/16)	56	16.7%	(5/30)
Hammersmith	76	53.8%	(35/65)	82	52.1%	(37/71)	88	47.0%	(31/66)
Harefield	30	56.0%	(14/25)	40	46.9%	(15/32)	61	54.2%	(26/48)
Hillingdon	83	25.6%	(10/39)	63	27.3%	(6/22)	68	15.8%	(6/38)
Homerton	43	4.8%	(1/21)	39	26.3%	(5/19)	44	4.8%	(1/21)
King's College	167	39.3%	(33/84)	189	41.7%	(45/108)	189	36.5%	(46/126)
King George	56	4.8%	(1/21)	47	0.0%	(0/17)	57	4.8%	(1/21)
Kingston	63	24.0%	(6/25)	56	8.3%	(2/24)	64	16.1%	(5/31)
Newham	77	6.7%	(2/30)	70	7.1%	(2/28)	80	10.3%	(3/29)
North Middlesex	119	8.0%	(4/50)	89	24.2%	(8/33)	107	17.3%	(9/52)
Northwick Park	126	22.8%	(13/57)	98	26.9%	(14/52)	110	9.6%	(5/52)
Princess Royal	66	17.9%	(5/28)	60	12.5%	(4/32)	59	3.1%	(1/32)
Queen Elizabeth	110	18.6%	(8/43)	101	18.6%	(8/43)	107	15.9%	(7/44)
Queen's Romford	129	4.7%	(2/43)	107	8.0%	(4/50)	119	9.6%	(5/52)
Royal Free	133	44.4%	(40/90)	132	47.7%	(41/86)	150	42.5%	(45/106)
Royal London	91	24.1%	(13/54)	78	22.6%	(7/31)	86	18.4%	(7/38)
St George's	183	39.0%	(41/105)	168	42.9%	(48/112)	184	36.4%	(47/129)
St Helier	41	21.4%	(3/14)	53	17.4%	(4/23)	44	10.0%	(2/20)
St Mary's	87	12.2%	(5/41)	76	23.7%	(9/38)	70	25.7%	(9/35)
St Thomas'	116	47.5%	(28/59)	129	38.5%	(30/78)	112	47.8%	(32/67)
University College Hospital	35	26.1%	(6/23)	33	40.0%	(8/20)	34	26.7%	(4/15)
University Hospital Lewisham	70	24.1%	(7/29)	51	11.5%	(3/26)	58	17.2%	(5/29)
West Middlesex	88	13.3%	(4/30)	66	0.0%	(0/24)	78	9.4%	(3/32)
Whipps Cross	86	17.1%	(6/35)	89	16.2%	(6/37)	76	16.7%	(5/30)
Whittington	39	21.4%	(3/14)	35	7.1%	(1/14)	32	18.8%	(3/16)

** Patients conveyed to non- London hospitals (n=12) are excluded from the table.*

^ Barts Health opened its Heart Centre at their St. Bartholomew Hospital site in April 2015.

+ Denominators exclude patients with unknown survival outcomes.

Appendix 3: 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	
Barts Health	93	17.2% (16)	65.6% (61)	17.2% (16)	41.8% (38/91)
Essex Cardiothoracic Centre*	5	20.0% (1)	80.0% (4)	0% (0)	60.0% (3/5)
Hammersmith◆	69	13.2% (9)	70.6% (48)	16.2% (11)	37.9% (25/66)
Harefield	41	17.1% (7)	63.4% (26)	19.5% (8)	43.9% (18/41)
King's College	63	15.9% (10)	73.0% (46)	11.1% (7)	49.1% (27/55)
Royal Free	68	11.8% (8)	70.6% (48)	17.6% (12)	41.8% (28/67)
St George's	57	26.3% (15)	61.4% (35)	12.3% (7)	37.0% (20/54)
St Peter's Chertsey#	0	-	-	-	-
St Thomas'	24	12.5% (3)	70.8% (17)	16.7% (4)	50.0% (12/24)

** Essex Cardiothoracic Centre extended their catchment area and inclusion criteria in January 2017.*

◆ One patient conveyed to Hammersmith did not have their initial arrest rhythm documented.

 # St Peter's Chertsey accepted patients from the LAS in July 2016.

+ Denominators exclude patients with unknown survival outcomes.

Appendix 4: Cardiac arrest patients under 35 years old

	Under 1	1-8	9-18	19-35
Number of patients:	54	28	69	312
Gender:				
Male	51.9% (28)	53.6% (15)	66.7% (46)	75.6% (236)
Female	48.1% (26)	46.4% (13)	33.3% (23)	24.4% (76)
Unknown	-	-	-	-
Arrest location:				
Private	92.6% (50)	82.1% (23)	53.6% (37)	51.3% (160)
Public	7.4% (4)	17.9% (5)	44.9% (31)	48.7% (152)
Not documented	-	-	1.5% (1)	-
Witnessed[◊]:				
Bystander	16.7% (9)	46.4% (13)	44.9% (31)	39.7% (124)
LAS staff	16.7% (9)	10.7% (3)	11.6% (8)	15.4% (48)
Unwitnessed	66.7% (36)	39.3% (11)	43.5% (30)	44.6% (139)
Not documented	-	3.6% (1)	-	0.3% (1)
Bystander CPR[#]:				
Yes	71.1% (32/45)	80.0% (20/25)	73.8% (45/61)	72.0% (190/264)
No	28.9% (13/45)	20.0% (5/25)	26.2% (16/61)	28.0% (74/264)
Initial rhythm[◊]:				
Asystole	77.8% (42)	71.4% (20)	62.3% (43)	56.4% (176)
PEA	13.0% (7)	14.3% (4)	24.6% (17)	27.6% (86)
VF/ Pulseless VT	0% (0)	7.1% (2)	8.7% (6)	13.8% (43)
Not Documented	9.3% (5)	7.1% (2)	4.3% (3)	2.2% (7)
ROSC sustained to hospital:				
Yes	24.1% (13)	32.1% (9)	24.6% (17)	29.5% (92)
No	75.9% (41)	67.9% (19)	75.4% (52)	70.5% (220)
Survived to discharge[+]:				
Yes	8.0% (4)	13.0% (3)	16.2% (11)	9.5% (28)
No	92.0% (46)	87.0% (20)	83.8% (57)	90.5% (268)

◊ Totals for <1 years old within the witnessed group and <1 years old, 1-8 years and 9-18 years within the initial rhythm group do not equal 100% due to rounding.

[#] Figures exclude arrests witnessed by LAS staff.

+ Denominators exclude patients with unknown survival outcomes.