Cardiac Arrest Annual Report: 2018/19

December 2019

Contents

Cardiac arrest overview 2018/19 infographic

Cardiac Arrest Overview | 2018-19

10,152
Total patients seen

39%
Had resuscitation attempted

65% **35%**

61 years* 67 years*
*Median age

50%	16%	34%
Bystander witnessed	LAS witnessed	Unwitnessed

64%	36%
Bystander CPR	No bystander CPR

999 call to scene → **07:28**

999 call to CPR → **09:35**

999 call to defibrillation → **10:38**

Initial Rhythm

VF/VT	22%
PEA	30%
Asystole	47%

Overall **Utstein**

ROSC to hospital **35.7%** **62.6%** ROSC to hospital

Survival **10.8%** **36.6%** Survival

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1   Introduction

This report presents key information regarding the response and treatment that out-of-hospital cardiac arrest patients received from the London Ambulance Service NHS Trust (LAS), the presenting factors that may have affected survival, and the outcome of these patients.

10,152 patients suffered an out-of-hospital cardiac arrest between 1st April 2018 to 31st March 2019 and our clinicians attempted to resuscitate **4,004** (**39.4**%) of these patients. Resuscitation efforts were not undertaken for **6,148** (**60.6**%), with 4,386 of these patients being recognised as deceased on arrival of the clinician, and the remaining 1,762 had in place a Do Not Attempt Cardio-Pulmonary Resuscitation (DNA-CPR) order, advanced directive or equivalent, or the patient's death was expected.

Data were sourced from the LAS's 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 was collected from hospital patient records and national databases.

The following information refers to the clinical care provided and the outcomes of the **4,004** patients where resuscitation was attempted.

2 Profile of arrests

Gender □, n (%)	
Male	2,602 (65.0)
Female	1,401 (35.0)
Unknown	1 (<0.1)

Age, mean (median) in years	
Overall	63 (67)
Male	61 (64)
Female	67 (72)

Race, n (%)	
White	2,386 (59.6)
Black	344 (8.6)
Asian	334 (8.3)
Mixed	17 (0.4)
Other	176 (4.4)
Unable to obtain	694 (17.4)
Not documented	53 (1.3)

Location □, n (%)	
Private location	**2,918 (72.9)**
Home	2,727 (93.5)
Care home	191 (6.5)
Public location	**1,086 (27.1)**
Street	434 (40.0)
Work	103 (9.5)
Healthcare facility	182 (16.7)
Public transport	77 (7.1)
Social venue	52 (4.8)
Shop	36 (3.3)
Park/wood/river	41 (3.8)
Hotel/Hostel	40 (3.7)
Leisure centre/sports club	39 (3.6)
Airport	15 (1.4)
Other	67 (6.2)

Peak occurrence	
Time of day (hh:mm)	08:00-11:59 23.3% (n=932)
Day	Sunday 15.3% (n=613)
Month	December 10.5% (n=421)

Chief complaints at the 999 call, n (%)□	
Cardiac arrest	2,085 (52.1)
Unconscious/fainting	448 (11.2)
Breathing problems	398 (9.9)
Falls	162 (4.0)
Other	780 (19.5)
111 NHS Transfers	73 (1.8)
HCP Admissions	58 (1.4)

Table 1: Profile of cardiac arrests where resuscitation was attempted (n=4,004)

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

3   LAS response times

3.1   Response time by call category

Calls received via 999 are triaged, according to severity, from Life Threatening (Category 1) to suitable for 'Hear & Treat' (Category 5). A set of pre-triage questions help the early recognition of life-threatening conditions by call takers (e.g. ineffective breathing may indicate cardiac arrest), and enable the rapid dispatch of ambulance resources. Each category of call has a target response time, as defined by NHS England's Ambulance Response Programme (ARP)[1], presented in the table 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 connecting. Clock stop The arrival of the first LAS vehicle able to transport the patient to hospital.
Category 3 (Urgent)	120 (90th centile)		
Category 4 (Less urgent)	180 (90th centile)		
Category 5 (Hear & Treat)			

Category	n (%)	Mean	Median	90th Centile
Category 1	3,047 (76.1)	7	6	10
Category 2	792 (19.8)	16	13	31
Category 3	144 (3.6)	20	13	48
Category 4	17 (0.4)	57	41	114
Category 5^	4 (0.1)	26	15	50
Overall	**4,004**	**9**	**7**	**16**

Table 2: Response times by category (minutes)

^ *Category 5 replaced Category C4H from November 2018. Patients allocated Category 5 are mainly managed by the LAS Clinical Hub as they are often suitable to be best dealt with via Hear and Treat.*

3.2   Key time intervals

Time interval	Median time
999 call^ – arrive on scene+	07:28
999 call^ – LAS CPR*	09:35
999 call^ – LAS defibrillation*~	10:38

Table 3: Median time intervals from 999 call (minutes)

^ Time the 999 call was connected to the Emergency Medical Dispatcher (EMD)
+ Time from 999 call to the arrival of the first dispatched resource arriving on scene.
* Excludes LAS witnessed arrests.
~ Based on an initial rhythm of VF/VT.

- Over three-quarters **(76.1%)** of patients received a **Category 1** response. The mean response was **7 minutes** for those patients allocated to **Category 1** which meets the national target.

- For **all** cardiac arrest patients, the mean time taken for a response to arrive was **9 minutes** overall.

- The median time from 999 call to LAS CPR was **9.5 minutes** whilst the median time to defibrillation was **10.5 minutes**.

4   Bystander interventions

4.1   Bystander witnessed and CPR rates
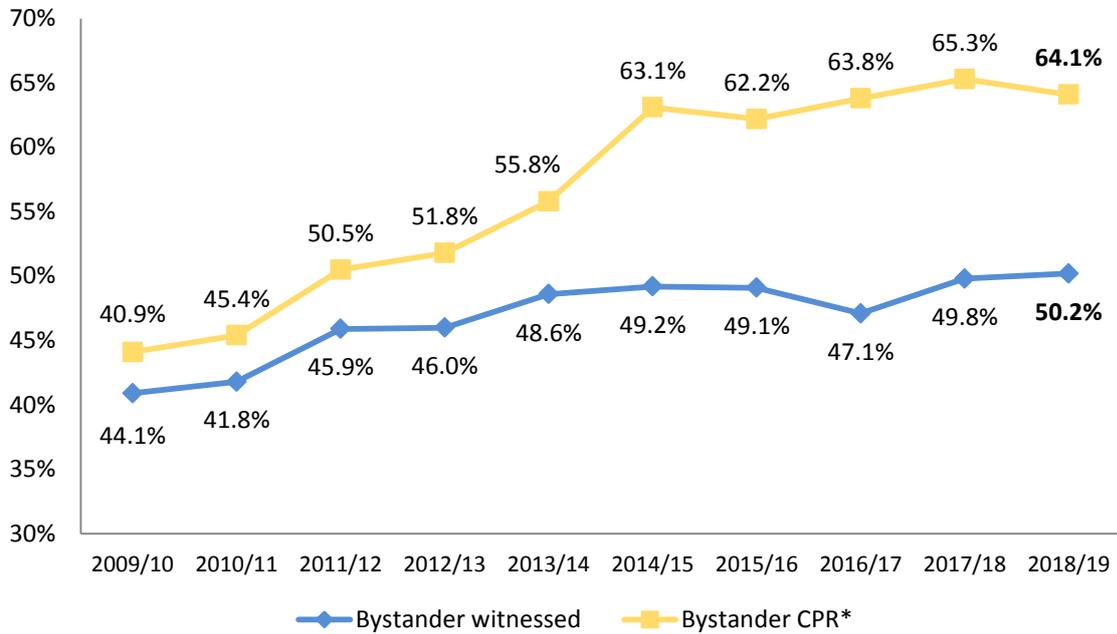
Figure 1: Bystander witnessed arrests and bystander CPR by year
Excludes LAS witnessed arrests

- **Bystander witnessed** rates are the **highest** observed to date with more than **half** (50.2%, n=2,012) of cardiac arrests where resuscitation was attempted being **bystander witnessed**.

- The number of patients receiving **bystander CPR** decreased slightly by 1.2% to **64.1%** (n=2,166) but this still represents an increase on all years preceding 2017/18.

4.2   Public Access Defibrillator (PAD)
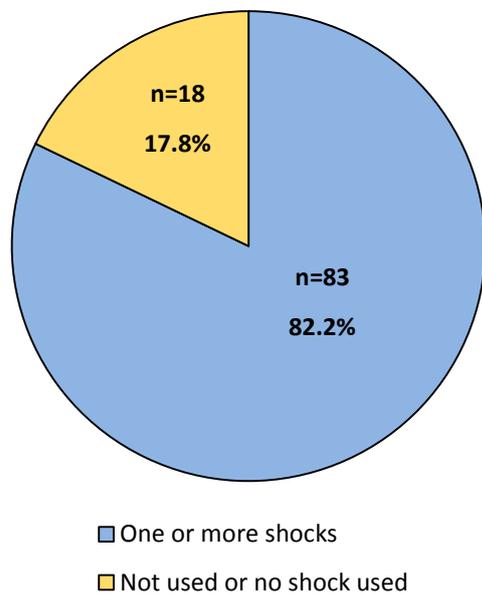
Figure 2: Deployment of a PAD
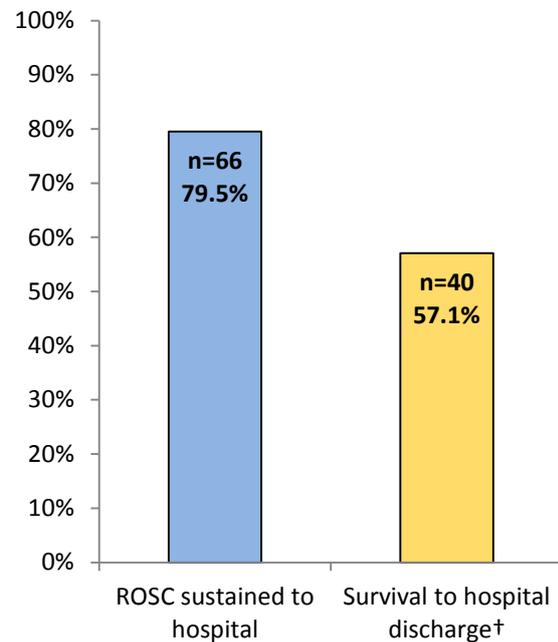
Figure 3: Outcomes where PAD was used

† *Excludes 13 patients with unknown outcomes.*

- A PAD was deployed for 101 cardiac arrests, with **one or more shocks** being delivered by members of the public in **83** cases.

- Of the 83 patients where a PAD was used to deliver a shock:

    - **89.2%** arrests (n=74) were **bystander witnessed** - a 5.7% decrease compared to last year.

    - **All** patients received **bystander CPR**.

    - **79.5%** (n=66/83) had **ROSC** sustained to hospital (14.9% increase from last year).

    - **Survival** to hospital discharge was **57.1%** (n=40/70) - an increase of 5.8% compared to last year (51.3%).

5   Clinical Presentation

5.1   Aetiology
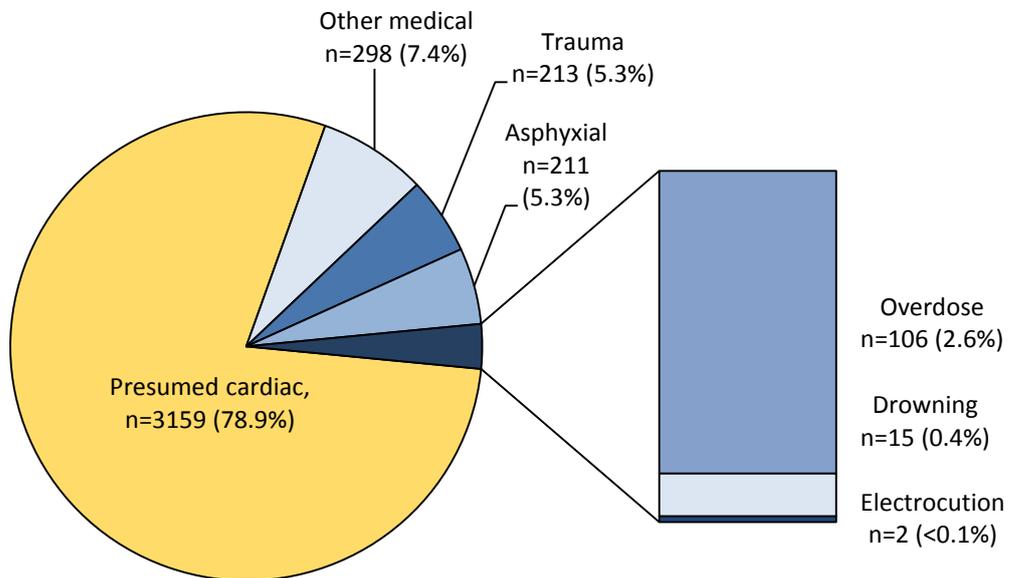
Figure 4: Breakdown of patient aetiology

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

- **Presumed cardiac** aetiology remains the predominant cause of cardiac arrest (78.9%)

5.2 Initial Rhythm
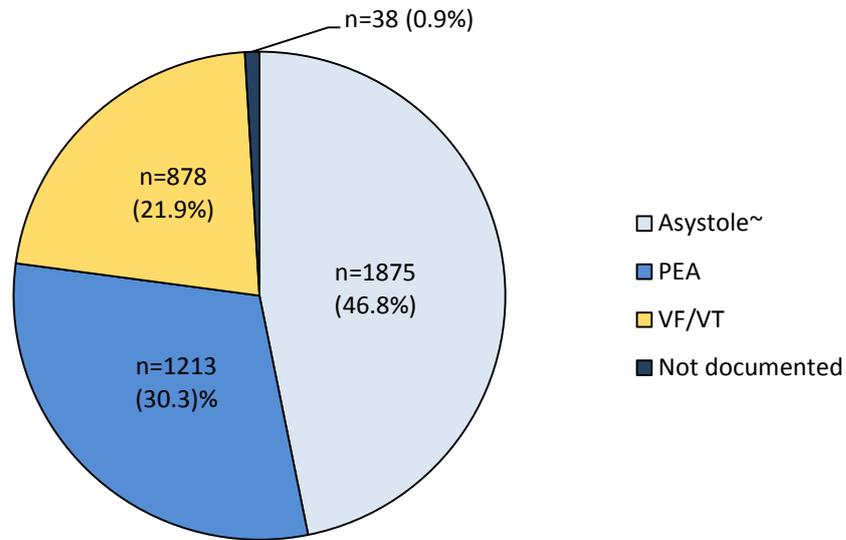
Figure 5: Breakdown of initial arrest rhythm

~ Includes paediatric bradycardia (n=1).

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

- Despite seeing a 3.3% decrease from last year, **Asystole (46.8%)** remains the predominant initial rhythm.

- **VF/VT** has increased by 1.6% from 20.3% to **21.9%** this year which is in line with an upward trend over the past five years.

6 Outcomes

6.1 Conveyance
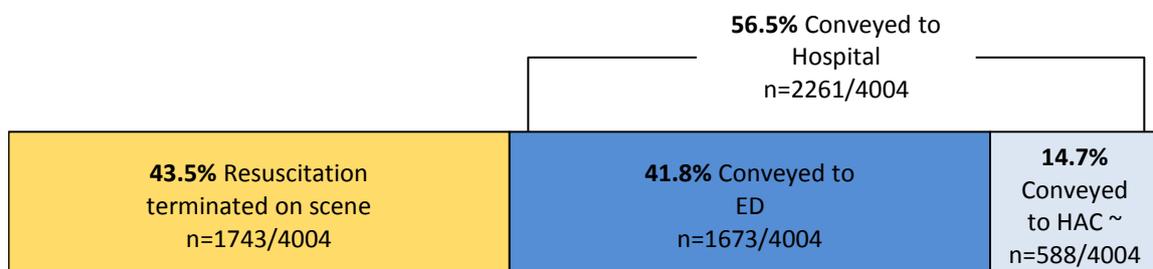
Figure 6: Breakdown of conveyance by destination

~ Includes all patients regardless of whether a STEMI was identified.

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 comparator group**[2,3]: a sub-group of patients for whom resuscitation was attempted following a cardiac arrest of a presumed cardiac cause, which was bystander witnessed, and presented in a shockable rhythm (see appendix 3).
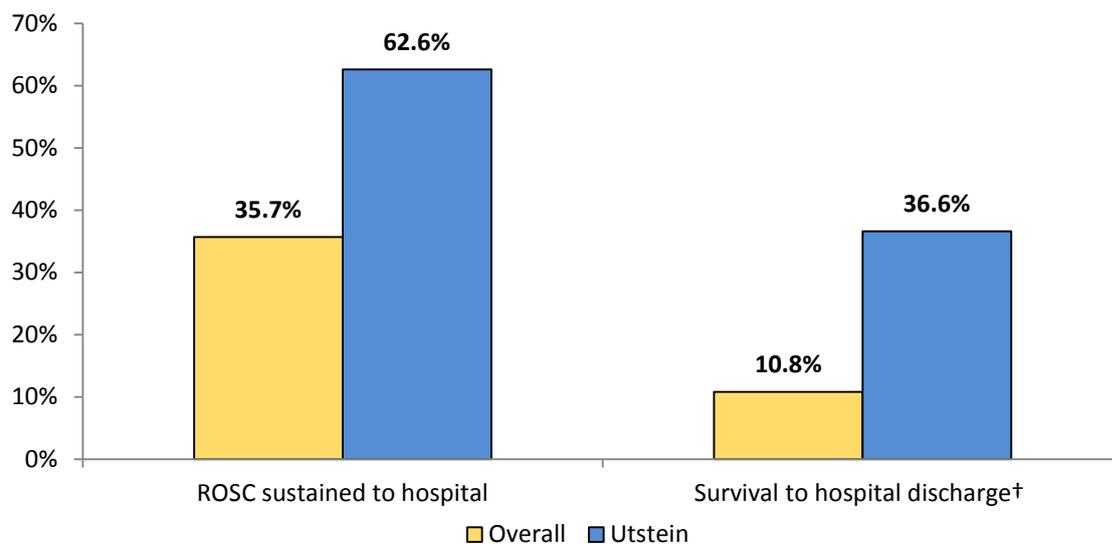
Figure 7: ROSC sustained to hospital and survival to hospital discharge for all patients where resuscitation was attempted ('overall') and the Utstein comparator group

† Unknown outcomes excluded from the overall (n=128) and Utstein (n=31) group

- **ROSC** to hospital and **survival** to discharge rates, for both the overall and Utstein groups, are the **highest** figures reported to date.

- **Overall ROSC** to hospital increased by 3.2% to **35.7%** (n=1,428/4,004; see Figure 8).

- **Overall survival** to hospital discharge increased by 1.4% to **10.8%** (n=419/3,876), up from 9.4% last year.

- For the **Utstein** comparator group, **ROSC** sustained to hospital arrival saw a marked increase of 6 % to **62.6%** (n=353/564).

- The **Utstein survival** rate of **36.6%** (n=195/533) is a 4.7% increase from last year (see Figure 9).
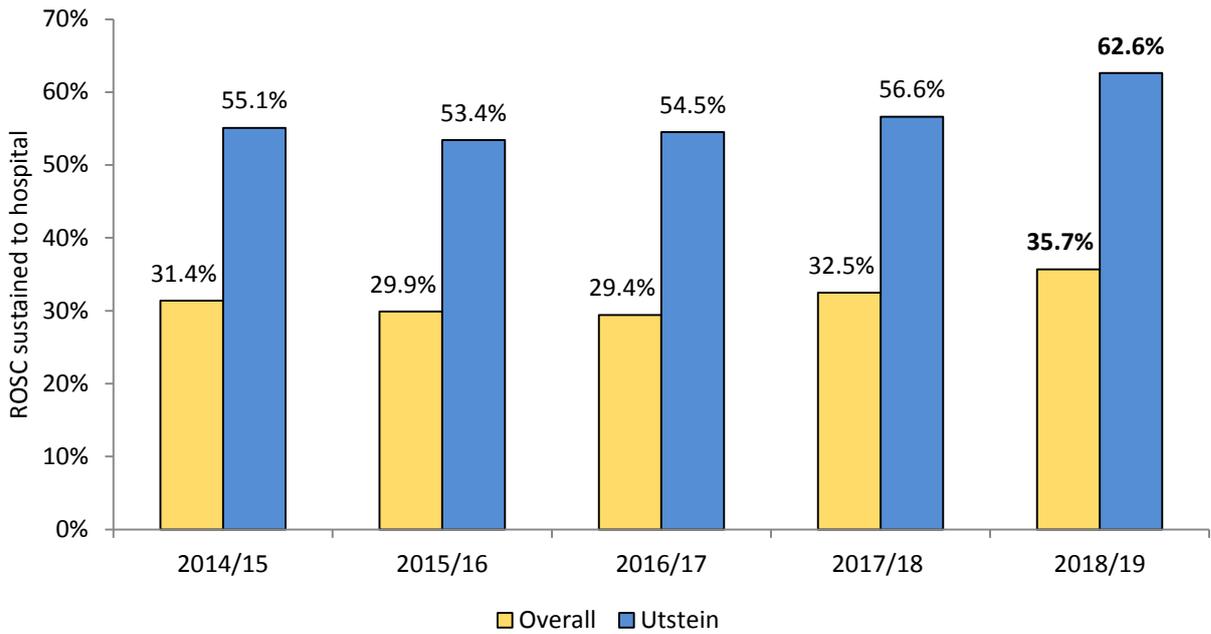
Figure 8: ROSC sustained to hospital per year for all patients where resuscitation was attempted
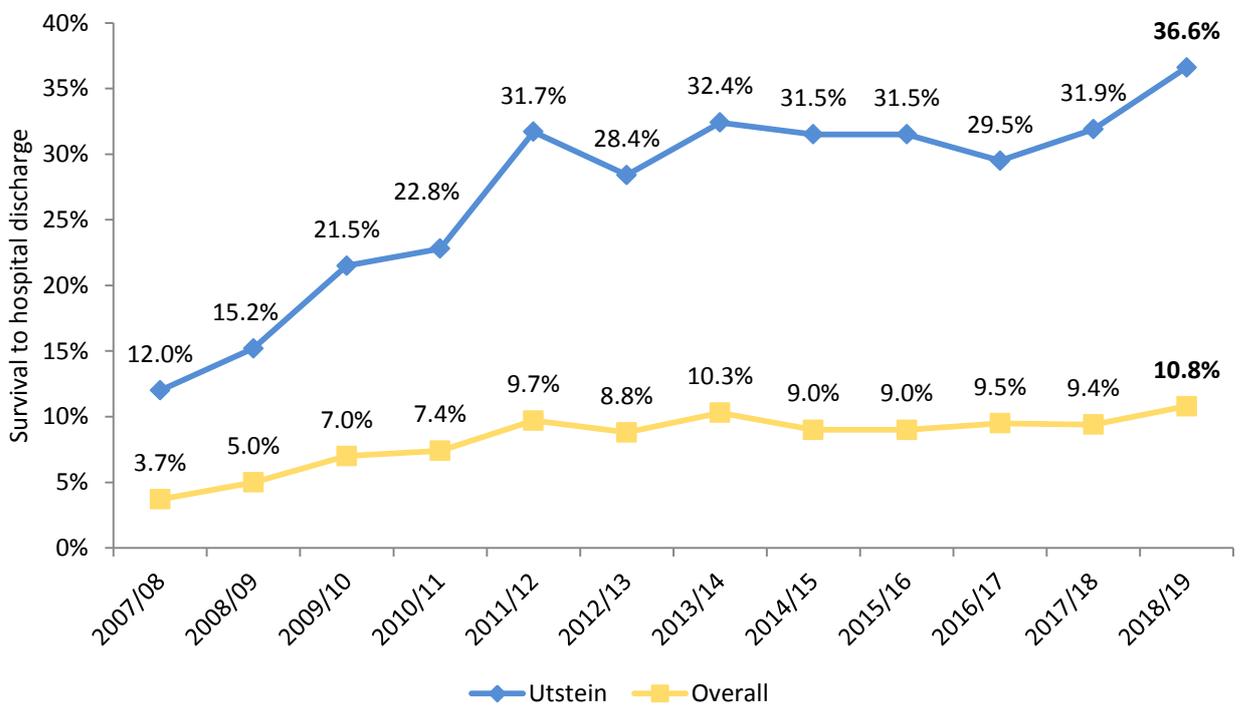
Figure 9: Survival to hospital discharge per year for all patients where resuscitation was attempted

7 Outcomes for patients conveyed to a Heart Attack Centre (HAC)

Cardiac arrest patients who have a ST-elevation Myocardial Infarction (STEMI), as identified by ambulance clinicians using a 12 Lead ECG, are conveyed to a HAC as part of a specialist pathway. The figure below shows the outcomes for this specific group of patients.
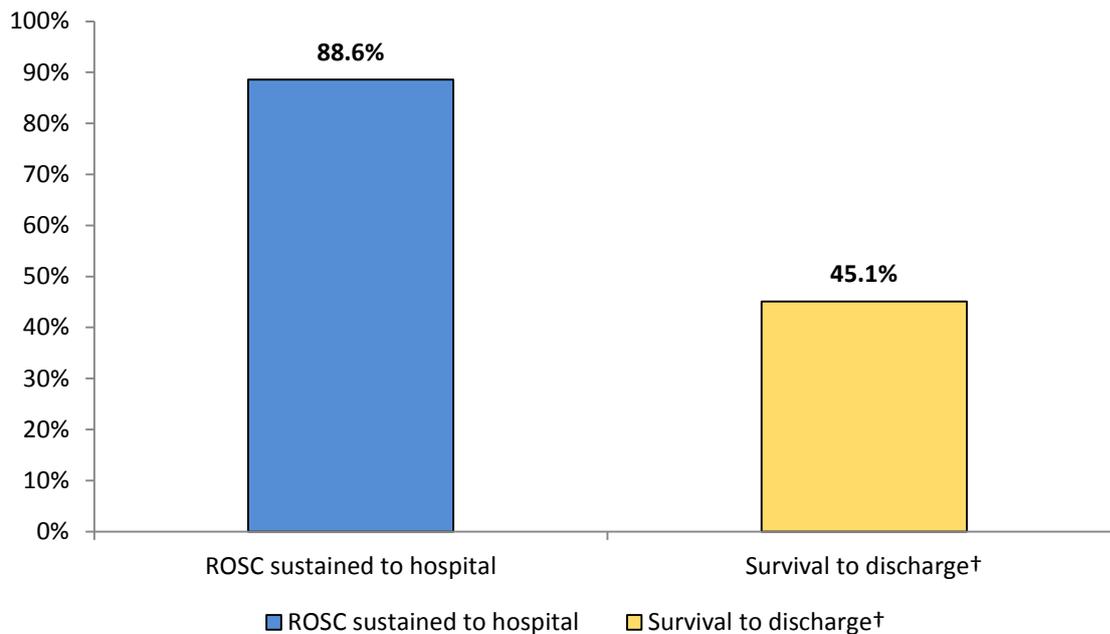
Figure 10: ROSC sustained to hospital and survival to discharge for patients conveyed to a HAC
† Denominator excludes patients with unknown survival outcomes (n=19).

- **387** patients with a suspected STEMI were conveyed to a HAC.

- **88.6%** (n=343/387) had ROSC sustained to hospital.

- As in previous years, the **majority** of these patients had an initial rhythm of **VF/VT** (72.1%, n=279) whilst asystole and PEA accounted for 10.9% (n=42) and 16.5% (n=64) respectively. Two patients (0.5%) did not have an initial rhythm documented.

- **Survival** to hospital discharge for patients within this specialist pathway remains higher than other group at **45.1%** (n=166/368).

- A breakdown of survival and initial rhythm for patients conveyed to specific London HACs can be found in Appendix 6.

15

8 LAS witnessed

LAS witnessed	n (%)*	ROSC sustained to hospital n (%)	Survival to discharge† n (%)
Asystole	136 (21.7)	49 (36.0)	12/131 (9.2)
PEA	342 (54.5)	113 (33.0)	25/331 (7.6)
VF/VT	138 (22.0)	90 (65.2)	73/127 (57.5)
All patients	627 (15.7)	257 (41.0)	114/597 (19.1)

Table 4: Outcome of LAS witnessed arrests
Not documented in 11 (1.8%) cases.
† Denominator excludes patients with unknown survival outcomes (n=30).

- LAS clinicians witnessed **627** patients suffer a cardiac arrest.

- **ROSC** sustained to hospital for this group showed a **negligible decrease** of 0.1% whereas **survival** to discharge showed an **increase** of 1.0% from 2017/18.

- More patients presented with an initial shockable rhythm (increase of 2.2% in VF/VT from 19.8% in 2017/18).

9 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 that the APPs attend those who are most likely to benefit from advanced skills.

APP patient outcomes	n (%)	Change^
ROSC sustained to hospital	684/1,584 (43.2)	↑3.5%
Survival to discharge†	213/1,530 (13.9)	↑0.8%

Table 5: APP skills and patient outcomes
† Denominator excludes patients with unknown survival outcomes (n=54).
^ Increase or decrease in percentage from 2017/18.

- In **1,584** cases, an APP was present and assumed primacy of care for the patient.

- Both **ROSC** sustained to hospital and **survival** have **increased** since 2017/18 to 43.2% and 13.9% (an increase of 3.5% and 0.8% respectively).

- For patients where an APP was present, ROSC and survival to discharge has remained higher than the overall LAS figures. The rate of VF/VT in these cases was 31.7%, which is 9.8% higher than the percentage reported for all resuscitation attempted patients.

10 Conclusion

This year, we have seen a continued improvement in ROSC sustained to hospital and survival to discharge for all patients, achieving the highest rates to date. Overall ROSC sustained to hospital rates increased by 3.2% to 35.7% (up from 32.5% in 2017/18), with the Utstein ROSC sustained to hospital rate showing the largest increase of 6% to 62.6% (from 56.6% in 2017/18). Overall survival increased by 1.4% to 10.8% (from 9.4% in 2017/18) whilst survival in the Utstein comparator group rose by 4.7% to 36.6% (from 31.9% in 2017/18).

The improvements in both ROSC and survival, particularly for the Utstein sub-group, may be partly explained by increases in the numbers of patients presenting with factors that are favourable for survival. For example, we have seen an increase in the proportion of patients presenting with a presumed cardiac aetiology (78.9% vs. 76.1% in 2017/18), an increase in bystander witnessed arrests (50.2% vs. 49.8% in 2017/18), and more patients with an initial rhythm of VF/VT (for whom early defibrillation can be advantageous) or PEA (where consideration of reversible causes is beneficial). In addition, nearly two thirds of all patients (64.1%) received bystander CPR, which is a higher proportion than in any year except 2017/18 (65.3%). Four more patients received a shock from a PAD this year and overall usage remains low. However, when a PAD was used, the survival rate was over 50%. This year we have also seen fewer resuscitation attempts (39.4% vs 41.2% in 2017-18) potentially highlighting a reduction in futile resuscitations.

The increases in some of the beneficial factors that we describe will likely have been influenced by the many quality improvement and service development initiatives that that the LAS undertook during 2018-19, as outlined below.

11 Quality Improvement Activity

The LAS's five-year clinical strategy (2016-2021) sets out plans to improve outcomes from out-of-hospital cardiac arrest. In line with this, during 2018/19 the LAS has:

- Been involved in ground-breaking cardiac arrest research. For example, we continued to recruit patients into the ARREST trial[4] (a randomised controlled trial aiming to determine the best post-resuscitation care pathway for patients without ST-segment elevation on their post-ROSC ECG); worked to set up the Sub-30 pilot study which will, during 2019-20, investigate the feasibility of implementing a pre-hospital advanced cardiac arrest team to establish ECMO in out-of-hospital cardiac arrest; worked with collaborators to publish, in the New England Journal of Medicine, the results of the PARAMEDIC2 trial[5] (which investigated the role of adrenaline on outcomes from cardiac arrest), and published additional cardiac-related papers in other peer-reviewed journals[6-10].
- Continued to contribute data to the UK's national out-of-hospital cardiac arrest registry.
- Developed a paediatric resuscitation checklist, building on the success of our adult cardiac arrest checklist, to support staff decision making and enable them to optimise the care they provide when treating children in cardiac arrest.

- Worked with London Coroners and paediatric leads across London to revise our guidance for the management of deceased children to ensure that we provide the best possible care to bereaved families.
- Continued to provide all front line staff with simulation-based resuscitation training as part of the Core Skills Refresher (CSR) and provided opportunities for 1,000 clinicians to receive comprehensive feedback on their CPR skills by attending 'pop up CPR' sessions.
- With help from Macmillan Cancer Support, we improved access to Coordinate My Care (CMC) allowing our clinicians to access palliative care records at the patient's side.
- Established an End of Life Care team within the service which, along with CMC, will improve staff confidence and improve the experience for patients, who are at, or nearing, the end of their lives, and will reduce the number of inappropriate resuscitation attempts.
- Downloaded 17% of defibrillator files following resuscitation attempts (an increase of 3% from 2017-18) allowing local managers and APPs to provide immediate post event feedback to clinicians, maximising their opportunities to learn and improve.
- Increased the number of Advanced Paramedic Practitioners (Critical Care) who provide advanced care for our most seriously ill and injured patients, including people who have had cardiac arrests or been involved in major trauma. Six new APPs were recruited in 2018/19 meaning there were 34 operational APPs pan-London at the end of the year.
- Continued to use defibrillators in AED mode when our clinicians arrive at the patient's side to ensure patients who present in a shockable rhythm receive the earliest possible defibrillation attempt.
- In April 2018 we began reporting quarterly to NHS England on a new post-resuscitation care bundle for adult cardiac arrest patients where ROSC is achieved on-scene. This post-resuscitation measure examines the delivery of a range of assessments and treatments for non-traumatic cardiac arrests, including: 12 lead ECG, blood pressure, blood glucose, end-tidal CO_2, oxygen and IV fluids. By being benchmarking against other ambulance services in England, and sharing our performance on this care bundle with local clinical managers, we aim to maximize the care we provide to this group of patients.
- Introduced a process to flag to local sector and clinical managers cases where clinician feedback may be required where either the full care bundle is not provided, or there is a question around a clinical decision.
- Continued to issue letters to call handlers and clinicians involved in the care of cardiac arrest patients who survive to leave hospital, to let know what happened to the patient and thank them for their role in achieving a positive outcome.
- Increased the number of public access defibrillators in the community by 332, bringing the total across London to 5,304 and provided training in CPR and basic life support to 2,168 members of the public in an effort to maximise the number of patients who receive CPR from a bystander prior to the arrival of our clinicians.
- Continued to work with the Metropolitan Police (through our co-responding initiative) and the GoodSAM smartphone app, increasing the likelihood of a trained responder attending a cardiac arrest with a defibrillator.

12 Looking Forward

Going forward, we will continue to work to improve outcomes from out-of-hospital cardiac arrest by exploring further opportunities to be involved in research in this area and continuing to review the care we provide in order to identify further areas for improvement. In 2019/20, we will complete a second thematic review into cases of missed VF and, to reduce both the likelihood of this happening and reduce the time to first shock, all of our clinicians will use defibrillators in AED mode. We will also aim to download at least 30% of defibrillator files and will look to invest in new technology to increase this further, allowing us to provide our clinicians with valuable feedback on the care they provide. In order to increase the number of patients who receive early defibrillation, we will increase the number of public access defibrillators in the community (targeting areas of low coverage), continue to train members of the public to deliver bystander CPR, and continue to work with GoodSam and our volunteer responders.

13 References

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5.   Perkins GD, Deakin CD, Quinn T, et al. A Randomised Trial of Epinephrine in Out-of-Hopsital Cardiac Arrest. The New England Journal of Medicine. 2018; 379(8): 711-721

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arrest and low bystander cardiopulmonary resuscitation rates in England. *European Heart Journal - Quality of Care and Clinical Outcomes*, 5 (1): 51-62

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10.   Fothergill, R., Emmerson, A., Iyer, R., et al. (2019). Repeated adrenaline doses and survival from an out-of-hospital cardiac arrest. *Resuscitation*, 138: 316-321

Acknowledgments

Glossary of abbreviations and terms

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

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

<u>Bystander</u> – A lay person or non-Emergency Medical Service personnel.

<u>Call Connect</u> – The time the 999 call is connected to the ambulance service.

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

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

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

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

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

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

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

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

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

<u>Return of Spontaneous Circulation</u> (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.

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

<u>Utstein</u> – 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.

<u>Witnessed</u> – Either seen or heard by a bystander or seen by LAS staff.

Appendix 1: ROSC sustained to hospital and Survival to discharge by aetiology

Aetiology	n (%)□	ROSC sustained to hospital n (%)	Survived to discharge† n (%)
Presumed cardiac	3,159 (78.9)	1,149 (36.4)	368/3,071 (12.0)
Other medical	298 (7.4)	98 (32.9)	18/289 (6.2)
Trauma	213 (5.3)	28 (13.1)	6/209 (2.9)
Asphyxial	211 (5.3)	110 (52.1)	14/200 (7.0)
Overdose	106 (2.6)	42 (39.6)	13/95 (13.7)
Drowning	15 (0.4)	1 (6.7)	0/11 (0.0)
Electrocution	2 (<0.1)	0 (0.0)	0/2 (0.0)

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

† *Denominators exclude patients with unknown survival outcomes (n=128).*

Appendix 2: ROSC sustained to hospital and Survival to discharge by initial rhythm

LAS recorded initial rhythm*	n (%)□	ROSC sustained to hospital		Survival to discharge†	
		n (%)	Change^	n (%)	Change^
Asystole~	1,875 (46.8)	432 (23.0)	↑1.9%	31/1,846 (1.7)	↑0.4%
PEA	1,213 (30.3)	454 (37.4)	↑1.2%	71/1,172 (6.1)	↓0.4%
VF/VT	878 (21.9)	521 (59.3)	↑4.9%	302/829 (36.4)	↑3.5%

* *Not documented in 38 (0.9%) cases.*

~ *Includes paediatric bradycardia (n=1).*

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

^ *Increase or decrease in percentage from 2017/18.*

† *Denominator excludes patients with unknown survival outcomes (n=128).*

Appendix 3: Outcomes for the Utstein comparator group

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                    ┌────────────────────────────────────────────┐
                    │  Cardiac aetiology & resuscitation attempted │
                    │                 n = 3,159                    │
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Not witnessed (inc.not recorded)	Bystander witnessed	Witnessed by LAS staff
n = 1,032 (32.7%)	n = 1,652 (52.3%)	n = 475 (15.0%)

Initial rhythm VF/VT	Other rhythms (inc. not recorded)
n = 564 (34.1%)	n = 1,088 (65.9%)

Bystander CPR	No Bystander CPR	Bystander CPR
n = 429 (76.1%)	n = 135 (23.9%)	n = 670 (61.6%)

ROSC at any time	ROSC not achieved
n = 416 (73.8%)	n = 148 (26.2%)

ROSC sustained to hospital	No ROSC sustained to hospital
n = 353 (62.6%)	n = 211 (37.4%)

Outcome data	No outcome data
n = 533 (94.5%)	n = 31 (5.5%)

Died in hospital	Discharged alive	Efforts stopped on scene
n = 240 (45.0%)	n = 195 (36.6%)	n = 98 (18.4%)

Appendix 4: Patient characteristics, response times, and outcomes per Clinical Commissioning Group (CCG)

Incident CCG*	Number of patients	Age (mean 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	101	62	53.5%	(54)	06:59	63.5%	(54)	84.2%	(85)	18.8%	(19)	34.7%	(35)	6.9%	(7)
Barnet	151	67	59.6%	(90)	07:45	69.7%	(92)	80.1%	(121)	17.9%	(27)	32.5%	(49)	14.1%	(21)
Bexley	117	68	62.4%	(73)	08:37	63.8%	(60)	83.8%	(98)	20.5%	(24)	30.8%	(36)	8.5%	(10)
Brent	151	63	70.2%	(106)	07:13	68.6%	(83)	82.1%	(124)	29.1%	(44)	40.4%	(61)	12.1%	(18)
Bromley	167	70	62.3%	(104)	07:21	61.5%	(80)	83.2%	(139)	24.6%	(41)	37.7%	(63)	10.7%	(17)
Camden	125	61	64.8%	(81)	06:59	69.1%	(76)	77.6%	(97)	24.0%	(30)	44.0%	(55)	16.3%	(20)
Central London	113	57	75.2%	(85)	06:35	65.0%	(67)	80.5%	(91)	32.7%	(37)	36.3%	(41)	14.9%	(15)
City & Hackney	109	61	70.6%	(77)	07:03	62.6%	(57)	78.0%	(85)	22.9%	(25)	34.9%	(38)	13.5%	(14)
Croydon	173	62	67.1%	(116)	07:50	70.5%	(105)	76.3%	(132)	20.8%	(36)	28.3%	(49)	7.6%	(13)
Ealing	143	61	69.9%	(100)	07:13	60.3%	(76)	77.6%	(111)	16.1%	(23)	35.0%	(50)	11.7%	(16)
Enfield	185	61	61.1%	(113)	07:42	68.2%	(107)	85.4%	(158)	24.9%	(46)	36.2%	(67)	13.7%	(25)
Greenwich	129	62	65.9%	(85)	07:30	64.4%	(67)	77.5%	(100)	27.1%	(35)	38.8%	(50)	9.7%	(12)
Hammersmith & Fulham	73	58	67.1%	(49)	06:24	61.7%	(37)	65.8%	(48)	23.3%	(17)	41.1%	(30)	10.0%	(7)
Haringey	133	65	59.4%	(79)	08:11	57.8%	(59)	80.5%	(107)	16.5%	(22)	36.1%	(48)	9.8%	(13)
Harrow	125	69	64.0%	(80)	07:10	52.8%	(57)	77.6%	(97)	22.4%	(28)	32.0%	(40)	7.3%	(9)
Havering	140	66	69.3%	(97)	07:49	64.8%	(83)	80.0%	(112)	24.3%	(34)	27.1%	(38)	10.5%	(14)
Hillingdon	166	65	70.5%	(117)	07:37	65.5%	(91)	78.9%	(131)	29.5%	(49)	45.2%	(75)	13.1%	(21)
Hounslow	125	64	71.2%	(89)	07:51	70.9%	(78)	80.0%	(100)	27.2%	(34)	41.6%	(52)	7.9%	(9)
Islington	100	61	62.0%	(62)	08:49	58.2%	(46)	69.0%	(69)	20.0%	(20)	39.0%	(39)	20.6%	(20)
Kingston	75	65	62.7%	(47)	06:37	64.5%	(40)	80.0%	(60)	26.7%	(20)	38.7%	(29)	15.1%	(11)
Lambeth	138	61	68.8%	(95)	07:18	66.4%	(81)	79.7%	(110)	16.7%	(23)	27.5%	(38)	8.4%	(11)
Lewisham	124	64	65.3%	(81)	07:57	58.6%	(58)	79.8%	(99)	20.2%	(25)	37.9%	(47)	10.6%	(13)
Merton	82	69	62.2%	(51)	07:02	44.8%	(30)	74.4%	(61)	17.1%	(14)	40.2%	(33)	12.2%	(10)
Newham	137	58	65.0%	(89)	07:12	64.9%	(74)	75.9%	(104)	19.0%	(26)	29.9%	(41)	6.6%	(9)
Redbridge	139	63	58.3%	(81)	07:20	61.5%	(72)	77.7%	(108)	18.0%	(25)	40.3%	(56)	11.8%	(16)
Richmond	84	65	69.0%	(58)	07:56	62.9%	(39)	73.8%	(62)	16.7%	(14)	32.1%	(27)	10.0%	(8)
Southwark	139	60	58.3%	(81)	07:33	66.1%	(80)	72.7%	(101)	18.7%	(26)	38.1%	(53)	5.7%	(7)
Sutton	95	67	56.8%	(54)	07:46	57.9%	(44)	76.8%	(73)	18.9%	(18)	32.6%	(31)	12.1%	(11)
Tower Hamlets	107	61	63.6%	(68)	07:33	58.7%	(54)	79.4%	(85)	19.6%	(21)	34.6%	(37)	7.5%	(8)
Waltham Forest	131	60	65.6%	(86)	07:20	70.3%	(83)	80.2%	(105)	21.4%	(28)	31.3%	(41)	8.4%	(11)
Wandsworth	117	64	67.5%	(79)	07:19	69.2%	(72)	84.6%	(99)	22.2%	(26)	30.8%	(36)	9.1%	(10)
West London	98	63	67.3%	(66)	07:06	65.9%	(56)	78.6%	(77)	19.4%	(19)	42.9%	(42)	12.8%	(12)

*Incidents in non-London CCGs (n=12).   ^Overall response times are measured from the time the call was connected by the operator.
#Figures exclude arrests witnessed by LAS staff.   +Denominators exclude patients with unknown survival outcomes.

Appendix 5: Patients with ROSC sustained to hospital who survived to discharge

Hospital name	2016/2017				2017/2018				2018/19			
	Number of patients conveyed	Sustained ROSC to hospital	Survival to discharge		Number of patients conveyed	Sustained ROSC to hospital	Survival to discharge		Number of patients conveyed*	Sustained ROSC to hospital	Survival to discharge[+]	
Barnet	41	17	12.5%	(2/16)	50	23	26.1%	(6/23)	30	17	20.0%	(3/15)
St Barts	133	119	57.8%	(67/116)	125	97	55.8%	(53/95)	132	117	50.0%	(58/116)
Charing Cross	31	14	21.4%	(3/14)	34	16	9.1%	(1/11)	37	25	20.0%	(5/25)
Chelsea & Westminster	19	10	25.0%	(2/8)	33	21	27.8%	(5/18)	24	17	14.3%	(2/14)
Croydon	87	40	15.8%	(6/38)	69	34	14.7%	(5/34)	70	35	29.4%	(10/34)
Darent Valley	15	5	20.0%	(1/5)	11	4	0%	(0/4)	6	2	50.0%	(1/2)
Ealing	44	16	18.8%	(3/16)	56	30	16.7%	(5/30)	43	22	18.2%	(4/22)
Hammersmith	82	73	52.1%	(37/71)	88	70	47.0%	(31/66)	88	80	51.3%	(40/78)
Harefield	40	32	46.9%	(15/32)	61	48	54.2%	(26/48)	51	42	45.0%	(18/40)
Hillingdon	63	23	27.3%	(6/22)	68	38	15.8%	(6/38)	74	41	13.2%	(5/38)
Homerton	39	19	26.3%	(5/19)	44	21	4.8%	(1/21)	25	12	0%	(0/9)
King's College	189	118	41.7%	(45/108)	189	138	36.5%	(46/126)	176	126	35.2%	(38/108)
King George	47	19	0.0%	(0/17)	57	21	4.8%	(1/21)	49	24	16.7%	(4/24)
Kingston	56	25	8.3%	(2/24)	64	31	16.1%	(5/31)	47	28	23.1%	(6/26)
Newham	70	30	7.1%	(2/28)	80	31	10.3%	(3/29)	70	30	20.7%	(6/29)
North Middlesex	89	33	24.2%	(8/33)	107	52	17.3%	(9/52)	94	55	27.8%	(15/54)
Northwick Park	98	52	26.9%	(14/52)	110	55	9.6%	(5/52)	95	48	15.2%	(7/46)
Princess Royal	60	32	12.5%	(4/32)	59	33	3.1%	(1/32)	63	29	13.8%	(4/29)
Queen Elizabeth	101	44	18.6%	(8/43)	107	45	15.9%	(7/44)	91	38	13.2%	(5/38)
Queen's Romford	107	55	8.0%	(4/50)	119	56	9.6%	(5/52)	95	45	20.5%	(8/39)
Royal Free	132	86	47.7%	(41/86)	150	107	42.5%	(45/106)	156	121	42.1%	(51/121)
Royal London	78	38	22.6%	(7/31)	86	44	18.4%	(7/38)	77	48	19.2%	(9/47)
St George's	168	122	42.9%	(48/112)	184	133	36.4%	(47/129)	141	104	43.8%	(42/96)
St Helier	53	24	17.4%	(4/23)	44	21	10.0%	(2/20)	41	22	4.8%	(1/21)
St Mary's	76	39	23.7%	(9/38)	70	42	25.7%	(9/35)	68	43	23.1%	(9/39)
St Thomas'	129	83	38.5%	(30/78)	112	71	47.8%	(32/67)	113	85	36.8%	(21/57)
University College Hospital	33	20	40.0%	(8/20)	34	15	26.7%	(4/15)	32	18	41.2%	(7/17)
University Hospital Lewisham	51	26	11.5%	(3/26)	58	30	17.2%	(5/29)	65	40	15.0%	(6/40)
West Middlesex	66	25	0.0%	(0/24)	78	38	9.4%	(3/32)	74	39	9.7%	(3/31)
Whipps Cross	89	38	16.2%	(6/37)	76	37	16.7%	(5/30)	70	34	11.8%	(4/34)
Whittington	35	15	7.1%	(1/14)	32	16	18.8%	(3/16)	47	26	30.8%	(8/26)

* Patients *conveyed to non- London hospitals (n=17) are excluded from the table.*

+ Denominators exclude patients with unknown survival outcomes.

Appendix 6: Rhythm and survival per Heart Attack Centre for cardiac arrest patients with a STEMI

Heart Attack Centre	Number of patients conveyed	Initial rhythm□			Sustained ROSC to hospital	Survival to discharge+
		Asystole	VF/VT	PEA		
St Barts	91	15.4% (14)	68.1% (62)	16.5% (15)	83	46.7% (42/90)
Essex Cardiothoracic Centre	6	16.7% (1)	83.3% (5)	0% (0)	5	50.0% (3/6)
Hammersmith	57	12.3% (7)	66.7% (38)	21.1% (12)	53	40.0% (22/55)
Harefield◆	32	6.3% (2)	75.0% (24)	15.6% (5)	26	41.4% (12/29)
King's College	58	3.4% (2)	75.9% (44)	20.7% (12)	52	47.9% (23/48)
Royal Free◆	71	14.1% (10)	71.8% (51)	12.7% (9)	61	52.1% (37/71)
St George's	47	10.6% (5)	68.1% (32)	21.3% (10)	38	40.9% (18/44)
St Peter's Chertsey	3	0% (0)	100.0% (3)	0% (0)	3	0% (0/3)
St Thomas'	22	4.5% (1)	90.9% (20)	4.5% (1)	22	61.9% (13/21)

◆ *One patient conveyed to Harefield and one patient conveyed to the Royal Free did not have their initial arrest rhythm documented.*
+ Denominators exclude patients with unknown survival outcomes.
□ *The total percentages do not equal 100% due to rounding.*

Appendix 7: Cardiac arrest patients under 35 years old

	Under 1	1-8	9-18	19-35
Number of patients:	54	40	56	282
Gender:				
Male	51.9% (28)	52.5% (21)	71.4% (40)	73.0% (206)
Female	48.1% (26)	47.5% (19)	28.6% (16)	27.0% (76)
Arrest location:				
Private	94.4% (51)	90.0% (36)	57.1% (32)	48.2% (136)
Public	5.6% (3)	10.0% (4)	42.9% (24)	51.8% (146)
Witnessed:				
Bystander	33.3% (18)	45.0% (18)	41.1% (23)	40.8% (115)
LAS staff	9.3% (5)	10.0% (4)	8.9% (5)	14.9% (42)
Unwitnessed	57.4% (31)	45.0% (18)	50.0% (28)	44.3% (125)
Bystander CPR[#]:				
Yes	65.3% (32/49)	66.7% (24/36)	70.6% (36/51)	69.2% (166/240)
No	34.7% (17/49)	33.3% (12/36)	29.4% (15/51)	30.8% (74/240)
Aetiology[□]:				
Presumed Cardiac	74.1% (40)	67.5% (27)	26.8% (15)	41.5% (117)
Other Medical	20.4% (11)	15.0% (6)	14.3% (8)	5.3% (15)
Trauma	1.9% (1)	0.0% (0)	32.1% (18)	27.7% (78)
Asphyxial/Respiratory	1.9% (1)	15.0% (6)	21.4% (12)	12.4% (35)
Overdose	0.0% (0)	0.0% (0)	5.4% (3)	11.0% (31)
Drowning/Submersion	1.9% (1)	0.0% (0)	0.0% (0)	2.1% (6)
Electrocution	0.0% (0)	2.5% (1)	0.0% (0)	0.0% (0)
Initial Rhythm:				
Asystole~	77.8% (42)	67.5% (27)	58.9% (33)	51.4% (145)
PEA	14.8% (8)	22.5% (9)	33.9% (19)	28.4% (80)
VF/Pulseless VT	0% (0)	7.5% (3)	5.4% (3)	17.7% (50)
Not Documented	7.4% (4)	2.5% (1)	1.8% (1)	2.5% (7)
ROSC sustained to hospital:				
Yes	25.9% (14)	32.5% (13)	12.5% (7)	35.5% (100)
No	74.1% (40)	67.5% (27)	87.5% (49)	64.5% (182)
Survived to discharge[+]:				
Yes	12.2% (6)	10.8% (4)	5.6% (3)	13.7% (37)
No	87.8% (43)	89.2% (33)	94.4% (51)	86.3% (234)

[#] *Figures exclude arrests witnessed by LAS staff.*
[□] *The total percentages for Under 1 aetiology do not equal 100% due to rounding.*
~ *Includes paediatric bradycardia (n=1).*

+ *Denominators exclude patients with unknown survival outcomes.*