



London Ambulance Service



NHS Trust

## Cardiac Arrest Annual Report: 2009/10

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## Introduction

From 1<sup>st</sup> April 2009 to 31<sup>st</sup> March 2010, 9,884 patients suffered an out-of-hospital cardiac arrest and were attended by the London Ambulance Service NHS Trust (LAS).

Clinical, operational and demographic information relating to each patient was gathered and analysed by the Clinical Audit and Research Unit. This information was sourced from completed Patient Report Forms (PRFs), Mobile Data Terminals (MDTs), defibrillator data files, Emergency Operations Centre (EOC) records and other data sources where available (e.g. Helicopter Emergency Medical Service paperwork). All patients who were conveyed to hospital following resuscitation attempts were traced and survival outcomes collected from national databases and hospital sources where possible.

This year, for the first time, this report also presents detailed information relating specifically to cardiac arrest patients under the age of 18 years (Appendix 2).

## Cause of Arrest

The LAS attended a total of 9,884 out-of-hospital cardiac arrests. Of these, 5,822 (58.9%) patients were deemed not suitable for resuscitation upon arrival of ambulance crews. Resuscitation was attempted for a total of 4,062 (41.1%) patients: 3,060 (31%) arrests were due to a presumed cardiac cause; 254 (2.5%) were the result of a traumatic event, and 748 (7.6%) were due to other non-cardiac, non-traumatic causes (e.g. terminal illness, respiratory disease or drug overdose).

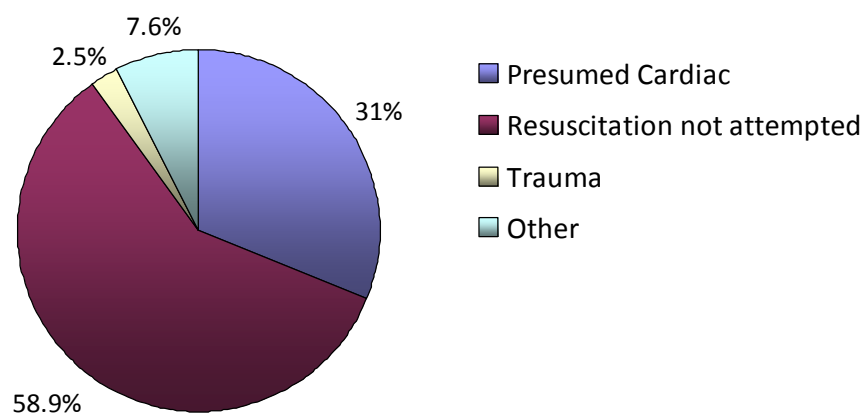


Figure 1 – Cause of arrest

## Profile of Arrests

The table below shows the demographic profile of all cardiac arrest patients, whether resuscitated or not. It further provides key information specifically for cases where resuscitation was attempted (regardless of the cause of arrest).

<b>All Cardiac Arrests</b>	
Number of cases:	9,884
Average age:	67 (0-105) years
Gender:	Male (61.6%, n=6,084) Female (37.7%, n=3,725) Missing information (0.7%, n=75)
Ethnicity:	White (58.8%, n=5,813) Mixed (0.4%, n=40) Asian/ British Asian (4%, n=399) Black/Black British (4.1%, n=402) Other ethnicity(2.3%, n=227) Unable to obtain (20.3%, n=2,006)* Missing information (10.1%, n=997)*
Most common day:	Monday (15.9%, n=1,575)
Most common month:	December (9.7%, n=961)
Location:	Private (87.1%, n=8,612) Public (12.6%, n= 1,241) Missing information (0.3%, n=31)
<b>Resuscitation Attempted Only (n=4,062)</b>	
Witnessed:	Bystander (40.9%, n=1,660) Not witnessed (37.1%, n=1,505) Crew witnessed (20.6%, n=836) Missing information (1.4%, n=61)
Bystander CPR:	35.1% (n=1,424)
Initial rhythm:	Asystole (48.4%, n=1,962) VF/VT (21.4%, n=870) PEA (27.6%, n=1,123) Missing information (2.6%, n=107)
ROSC:	28.9% (n=1,175)
ROSC sustained to hospital:	22.5% (n=913)

*\* Due to the nature and condition of cardiac arrests, patients are often unable to provide crews with ethnicity information. Crews therefore document on the PRF that they are unable to obtain this information.*

Table 1 – Profile of cardiac arrests in London

The remainder of this report focuses only on those patients who received resuscitation attempts following a cardiac arrest of a presumed cardiac cause (n=3,060).

### Patient Demographics

A greater number of cardiac arrest patients were male (64% vs. 36% female). Ages ranged from 0 – 103 years, with an average of 67. Females were older than males by an average of six years (71 vs. 65 years respectively). The distribution of age groups is shown in Figure 2.

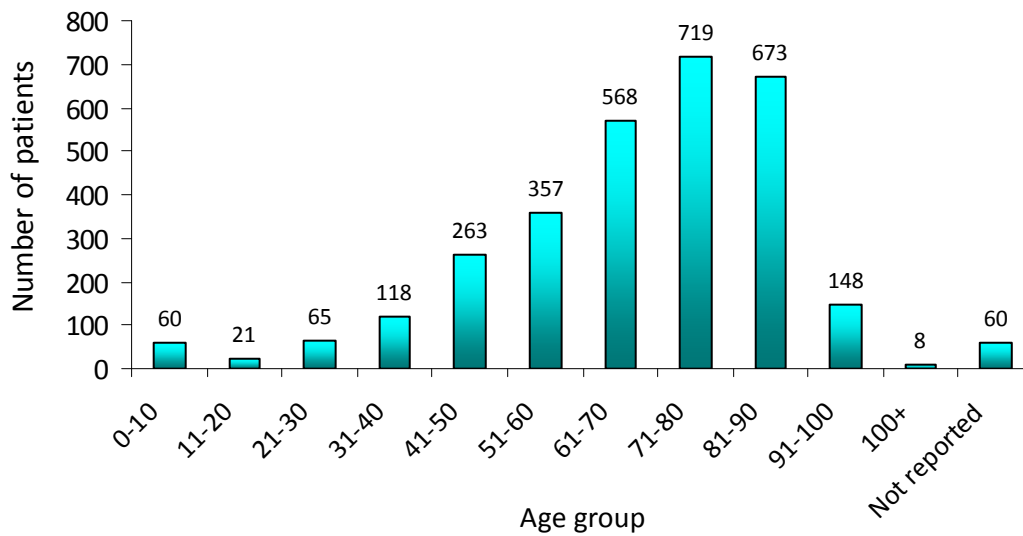


Figure 2 – Age groups of patients

### Day and Month of Cardiac Arrest

Cardiac arrests occurred most frequently on a Monday (15%, n=472) and least frequently on a Sunday (13.5%, n=413). The greatest number of arrests occurred during the month of December (11%, n=336), with fewer cardiac arrests occurring in April (5.6%, n=172).

### Location

The majority of cardiac arrests occurred in a private, residential location (79%, n=2,404). Of these, 2,047 were in the home and 357 in a care home facility. 21% (n=656) of cardiac arrests occurred in a public place, with the greatest number falling into the ‘other public location’ category, which includes airports, public transport and leisure facilities. Table 2 shows the occurrence of cardiac arrests by location.

Location	n	%
<b>Private</b>		
Home	2,047	66.9
Care Home	357	11.7
<b>Public</b>		
Street	286	9.3
GP Surgery	20	0.7
Work	50	1.6
Other Public	300	9.8

Table 2 – Location of cardiac arrests

### Response Times

Ambulance response times for 2009/10 are reported in Table 3. Response times achieved in 2008/09 have also been included for comparison purposes.

The average 999 call to arrival on scene interval remains consistent with that reported in 2008/09 at seven minutes. Defibrillation intervals have also remained unchanged from last year's figures. The average 999 call to arrival at hospital interval has increased by four minutes to 52 minutes, while the average overall job cycle time has decreased by one minute to 113 minutes.

Time Interval	2009/10 Average Time (mins.)	Previous Year (2008/09) Average Time (mins.)
999 (Call Connect)* - arrival on scene	7	7
999 (Call Connect)* - 1 <sup>st</sup> LAS defibrillation <sup>#</sup>	10	10
Arrival at scene - 1 <sup>st</sup> LAS defibrillation <sup>#</sup>	4	4
999 (Call Connect)* - arrival at hospital	52	48
Job cycle (Call Connect* - green)	113	114

\* Call Connect refers to the time that the call was connected to the ambulance service.

<sup>#</sup> includes only those patients with a bystander witnessed arrest and an initial rhythm of VF/VT.

Table 3 – Response intervals

### Witnessed Arrest

Almost half of all cardiac arrests (44%, n=1,335) were bystander witnessed (either seen or heard) and a further 19% (n=581) were witnessed by LAS crews. 36% (n=1,101) of patients had a cardiac arrest that was not witnessed. Cardiac arrests were more frequently witnessed in a private compared to a public location (70% vs. 30%). In 1% (n=43) of cases, there was no indication as to whether the cardiac arrest was witnessed or not.

### Bystander CPR

In just over one third of cases (35%, n=1,083) bystander CPR was commenced prior to the arrival of LAS crews. Bystander CPR was more common when the cardiac arrest was witnessed rather than not witnessed (63% vs. 37%). In addition, bystander CPR was also more likely to take place when the arrest occurred in a private location compared to those that occurred in public (67% vs. 33%).

### Initial Presenting Rhythm

As shown in previous annual reports, almost half of all cardiac arrest patients presented to ambulance crews with an Asystolic heart rhythm (46%, n=1,393). In addition, 26% (n=805) of patients presented with an initial rhythm of Ventricular Fibrillation (VF) or Ventricular Tachycardia (VT). Pulseless Electrical Activity (PEA) accounted for a further 26% (n=793). 2% (n=69) of all PRFs did not report the patient's initial arrest rhythm.

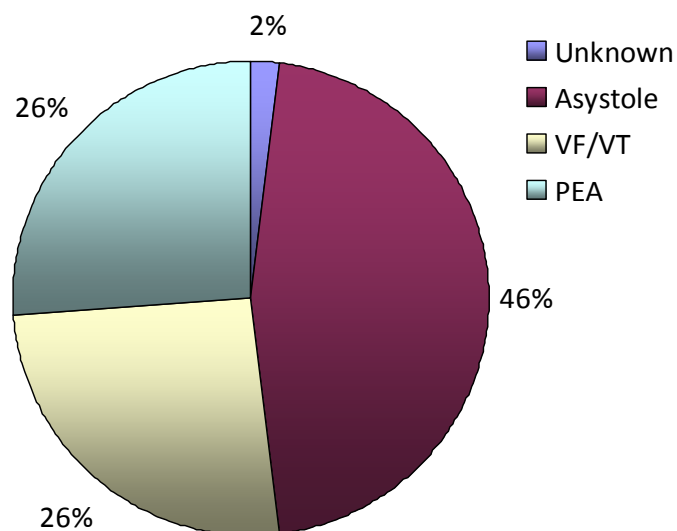


Figure 3 – Initial presenting rhythm

### Return of Spontaneous Circulation (ROSC)

ROSC was achieved at some point whilst in the care of LAS personnel in just under one third of cases (31%, n=940). Three quarters of these patients collapsed in a private location (75%, n=708); 72% (n=681) had a witnessed arrest (either by a bystander or a LAS crew), and a further 34% (n=323) received bystander CPR. The majority of patients where ROSC was achieved presented with an initial arrest rhythm of VF/VT (44%, n= 411). In 3% (n=78) of cases it was not documented whether ROSC was achieved at any point.

Of the 940 patients who achieved a ROSC, 77% sustained it to arrival at hospital (n=723). Therefore, of the total population of 3,060 patients, 24% (n=723) had a ROSC upon arrival at hospital; this represents an increase of 1% from 2008/09.

Of the 723 cases where ROSC was sustained to hospital, the highest occurrence was seen in the 51 - 60 year age group (29%, n=104). It is interesting to note that there is little variation in ROSC amongst the age groups from 21 – 90 (Figure 4).

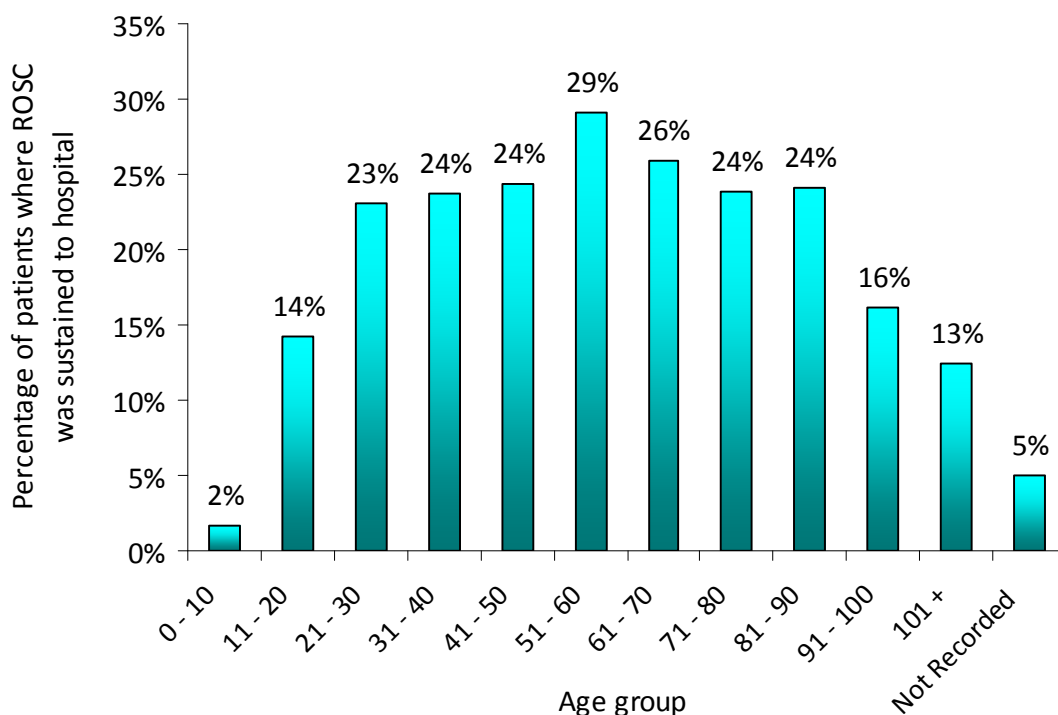


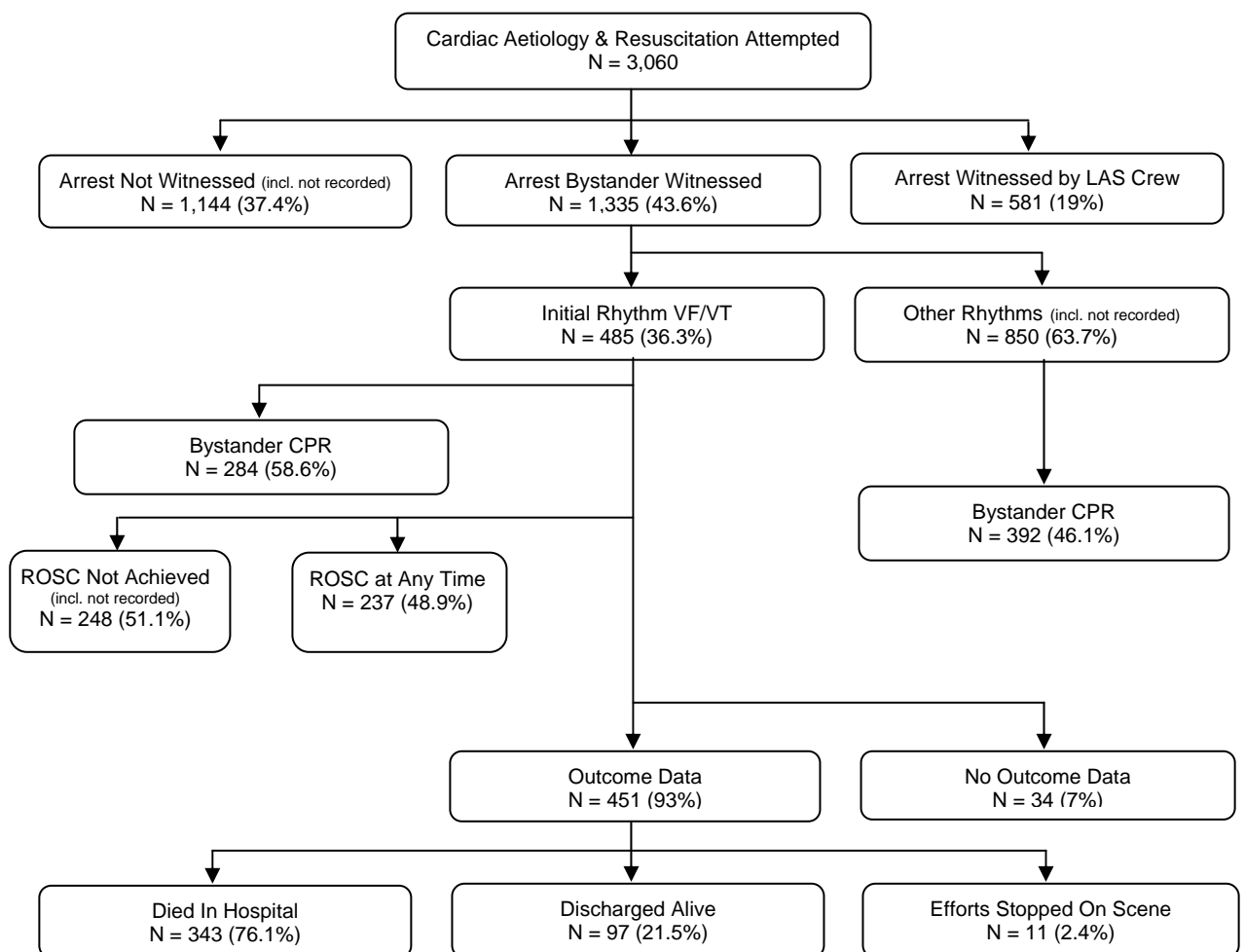
Figure 4 – Percentage of patients with ROSC sustained to hospital by age group.

## Survival Calculations

The LAS calculates two different types of cardiac arrest survival figures: an Utstein<sup>1</sup> survival rate and an overall survival rate.

### Utstein survival rate

The Utstein survival calculation is an internationally validated method for calculating out-of-hospital cardiac arrest survival rates that enables comparisons to be made between services. The Utstein calculation is the number of patients discharged alive as a proportion of the number of patients who had resuscitation attempted following a cardiac arrest of a presumed cardiac aetiology, where the arrest was bystander witnessed and the initial rhythm was VF/VT. Patients for whom outcomes could not be traced (n=34) were excluded from the survival analysis. Therefore, the valid denominator for the 2009/10 Utstein survival calculation was 451. The LAS Utstein survival rate for 2009/10 is 21.5%.

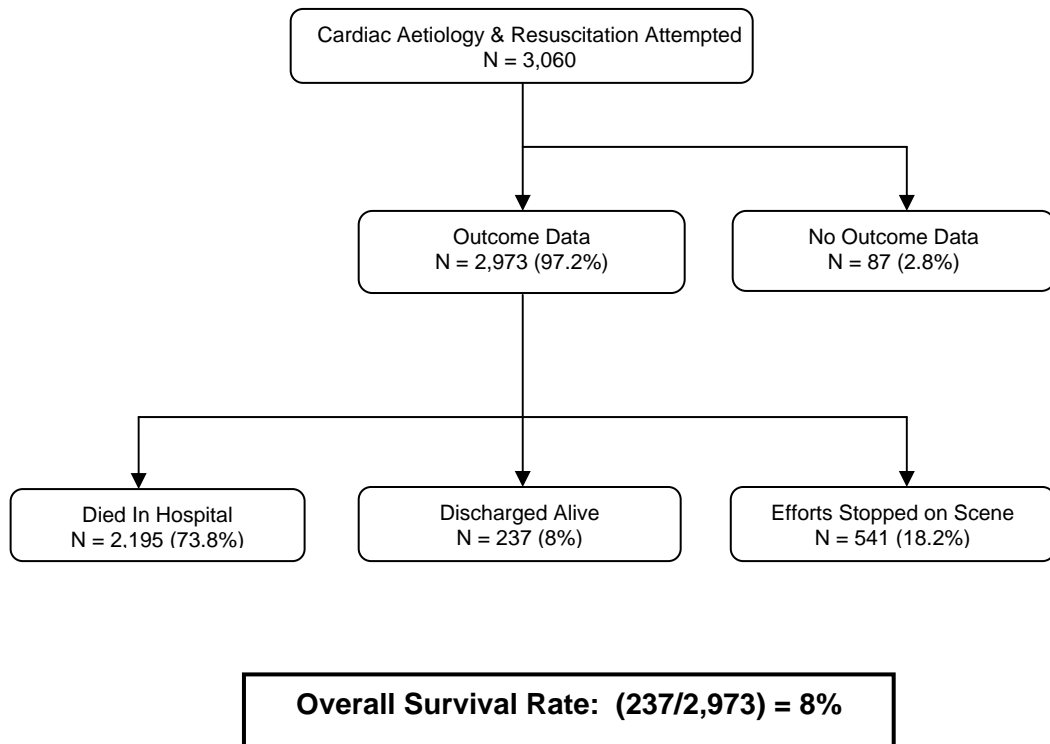


**Utstein Survival Rate: (97/451) = 21.5%**



**Overall survival rate**

The overall survival rate is based on those patients who had resuscitation commenced by the LAS following an out-of-hospital cardiac arrest of a presumed cardiac cause. The overall survival rate for 2009/10 is 8%.



**Survival from Crew Witnessed Cardiac Arrests Only**

Crew witnessed arrests accounted for 19% (n=581) of all out-of-hospital cardiac arrests during 2009/10. The table below illustrates the outcomes for this group. As 15 patients could not be traced to hospital, the valid denominator for overall survival was 566 and for Utstein was 149.

Outcome	n	%
Died on scene	35	6.2
Died in hospital	442	78.1
Overall survival rate	89/566	15.7
Utstein survival rate	69/149	46.3

Table 4 – Overall survival from crew witnessed arrests

## **Survival from Public Access Defibrillation**

During 2009/10 Public Access Defibrillators were deployed a total of 27 times. Information for all patients where a Public Access Defibrillator was deployed can be viewed in Appendix 1.

For the 20 patients where the cardiac arrest was of a presumed cardiac cause, survival outcomes were obtained for 19 patients. Four of these patients survived to hospital discharge, resulting in an overall survival rate of **21%** (n=4/19). Due to the small numbers within this group, an Utstein survival calculation was not appropriate.

## **Discussion**

The survival rates for the period of 1<sup>st</sup> April 2009 to 31<sup>st</sup> March 2010 are the highest ever achieved by the LAS to date. The Utstein survival rate has increased considerably by 6.3% (15.2% to 21.5%) from 2008/09 and the overall survival rate has increased by 2.4% (5.6% to 8%). Furthermore, a substantial increase of 11.6% (34.7% in 2008/09 to 46.3% in 2009/10) in survival has been achieved in patients whose arrests were witnessed by LAS crews.

This year, with the continued co-operation from many hospitals, the LAS has succeeded in obtaining the highest number of patient outcomes seen to date, with less than 3% missing. In addition, the quality of the information documented on PRFs by LAS crews has improved this year, with the percentage of missing information decreasing substantially compared to that reported in previous years. These two factors combined have enabled full and detailed analyses to be undertaken using robust data, and has allowed an accurate picture of cardiac care and survival to be formed.

When examining the factors that may have contributed to the increases observed, it can be seen that the proportion of witnessed arrests, bystander CPR rates, location of arrests and frequency of VF/VT presenting as the initial arrest rhythm have all remained consistent with those reported in 2008/09. Response times have also remained in line with those previously reported, with identical 999 call to scene (7 minutes), 999 call to defibrillation (10 minutes) and scene to defibrillation (4 minutes) times. An important element in the increase in survival is the improvement in the care and treatment of cardiac arrest patients by the LAS.

During 2009, LAS personnel received extensive training in advanced life support and on scene cardiac care. This included a structured education programme for Team Leaders (of which a large proportion centred on advanced life support techniques) and further cardiac-specific training for Paramedic and level 4 Emergency Medical Technicians. More specifically, the LAS introduced robust

ROSC guidelines focusing on the need to continue resuscitation on scene until ROSC is achieved in adult patients (or it is evident that further resuscitation attempts are futile and the patient has been recognised as life extinct). These guidelines also direct post-resuscitation management for patients achieving ROSC, which includes stabilising the patient prior to transportation to hospital. These factors may also explain the increase in average 999 call to arrive at hospital time (from 48 minutes in 2008/09 to 52 minutes in 2009/10) as crews will be continuing their resuscitative efforts and post-resuscitation management on scene. This training programme has been strengthened by poster campaigns focusing on the importance of effective chest compressions, and crews have been released from operational duties to receive additional defibrillation training, which again has helped to raise staff awareness of cardiac care across the Service.

In addition, in April 2009, the LAS upgraded to version 12 of the Medical Priority Dispatch System (MPDS) which is used to triage 999 calls. This version of MPDS includes a modification to the pre-arrival CPR instructions whereby callers are directed to perform a series of chest compressions prior to ventilations. In these instances, the number of initial chest compressions has increased from 400 to 600. Furthermore, to aid callers in the delivery of chest compressions, Emergency Medical Dispatchers (EMDs) now also count aloud the number of chest compressions to 100 beats per minute. These changes may also have contributed to the increase in survival.

During the period of this report, the LAS continued with its strong programme of clinical research aimed at further increasing the rate of survival for cardiac arrest patients. Further projects have been developed, and are being undertaken, that focus on improving basic and advanced life support techniques and post-resuscitation cardiac care.

In conclusion, by maintaining response times, investing in training, and upgrading the triage system - together with robust data collection - the LAS has continued to make improvements in cardiac care across London as reflected by the significant increase in survival figures.

## References

1. Cummins RO, Chamberlain DA, Abramson NS et al. Recommended Guidelines for Uniform Reporting of Data from Out-Of-Hospital Cardiac Arrest: The Utstein Style. *Annals of Emergency Medicine*, 1991; 20: 861-873.
2. Jacobs I, Nadkarni V, Bahr J, et al. Cardiac arrest and cardiopulmonary resuscitation outcome reports: update and simplification of the Utstein templates for resuscitation registries. A statement for healthcare professionals from a task force of the international liaison committee on resuscitation (American Heart Association, European Resuscitation Council, Australian Resuscitation Council, New Zealand Resuscitation Council, Heart and Stroke Foundation of Canada, InterAmerican Heart Foundation, Resuscitation Council of Southern Africa). *Resuscitation*, 2004; 63(3): 233-24

## Appendix 1: Public Access Defibrillation

The following information provides details on all 27 cases in which a Public Access Defibrillator was deployed. Survival information relating to patients whose cardiac arrest was of a cardiac cause can be found on page 9.

Public Access Defibrillation	
Patient Demographics	
Number of cases:	27
Average age:	58 (18 - 79 years)
Gender:	Male (85%); Female (15%)
Event Information	
Incident location:	Airport 33% (n=9) Public Transport 48% (n=13) Leisure centre 4% (n=1) Street 4% (n=1) Other location 11% (n=3)
Bystander witnessed:	Bystander (74%; n=20)
Bystander CPR:	82% (n=22)
Initial rhythm (as recorded by public defibrillator):	VF/VT (63%, n=17) Non-shockable (30%, n=8) Missing information (7%, n=2)
Average number (and range) of PAD shocks:	3 (1-10) shocks
ROSC:	41% (n=11)

## Appendix 2: Key findings for patients under 18 years

In 2009/10, a total of 195 patients under the age of 18 had a cardiac arrest. Resuscitation was attempted for 167 (85.6%) patients: 73 (37.4%) of these arrests were of a presumed cardiac cause, 31 (15.9%) were the result of a trauma, and 63 (32.3%) were due to other non-cardiac causes. The table below presents key findings for cardiac arrest patients under 18 years of age where resuscitation was attempted.

	Presumed cardiac	Trauma	Other non-cardiac
<b>Cardiac arrests: <i>n</i></b>	<b>73</b>	<b>31</b>	<b>63</b>
<b>Gender: <i>n</i> (%)</b>			
Male	36 (49.3)	20 (64.5)	34 (54)
Female	36 (49.3)	11 (35.5)	29 (46)
Not known (n)	1 (1.4)	-	-
<b>Presenting cardiac rhythm: <i>n</i> (%)</b>			
VF/VT	6 (8.2)	2 (6.5)	-
PEA	6 (8.2)	9 (29)	6 (9.5)
Asystole	44 (60.3)	19 (61.3)	48 (76.2)
Not documented	17 (23.3)	1 (3.2)	9 (14.3)
<b>Arrest witnessed: <i>n</i> (%)</b>			
Bystander	16 (21.9)	6 (19.4)	17 (27)
EMS personnel	4 (5.5)	7 (22.6)	7 (11.1)
Not witnessed	51 (69.9)	17 (54.8)	34 (54)
Not known (n)	2 (2.7)	1 (3.2)	5 (7.9)
<b>Bystander CPR: <i>n</i> (%)</b>			
Yes	41 (56.2)	19 (61.3)	26 (41.3)
No	32 (43.8)	11 (35.5)	36 (57.1)
Not known (n)	-	1 (3.2)	1 (1.6)
<b>Arrest location: <i>n</i> (%)</b>			
Public	8 (11)	17 (54.8)	6 (9.5)
Private	65 (89)	14 (45.2)	57 (90.5)
Not known (n)	-	-	-
<b>ROSC: <i>n</i> (%)</b>			
Yes	4 (5.5)	6 (19.4)	6 (9.5)
No	66 (90.4)	22 (71)	56 (88.9)
Not known (n)	3 (4.1)	3 (9.7)	1 (1.6)
<b>ROSC sustained to hospital: <i>n</i> (%)</b>			
Yes	3 (4.1)	5 (16.1)	6 (6.3)
No	67 (91.8)	22 (71)	57 (90.5)
Not known (n)	3 (4.1)	4 (12.9)	2 (3.2)
<b>Overall survival: (%) <i>n</i></b>	<b>2.7 (2/72)</b>	<b>0 (0/27)</b>	<b>3.3 (2/60)</b>