Research in OHCA – Past Developments & Current Research of Singapore

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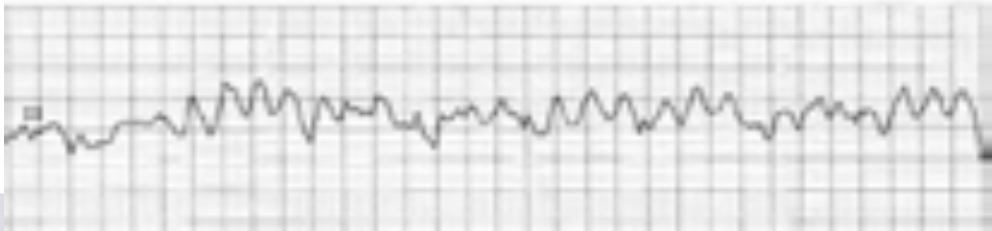
Previous Studies on out of hospital cardiac arrest

- CARE
  - Cardiac Arrest and Resuscitation Epidemiology
  - Completed Phase 3
- PADS
  - Public Access Defibrillation in Singapore
- CCR vs CPR
  - Continuous Chest Compression Resuscitation versus Cardiac Pulmonary Resuscitation

CARE

- The objective of the study is
  - To describe the epidemiology of out-of-hospital cardiac arrest (OHCA) in Singapore (What is our true incidence of OHCA?)
  - To describe the Emergency Medical Services (EMS) response
  - To identify possible areas for improvement



CARE

- Methodology
  - Prospective, Observational study
  - Multi-center, covers whole of Singapore
  - All OHCA conveyed by SCDF, excluding traumatic arrest

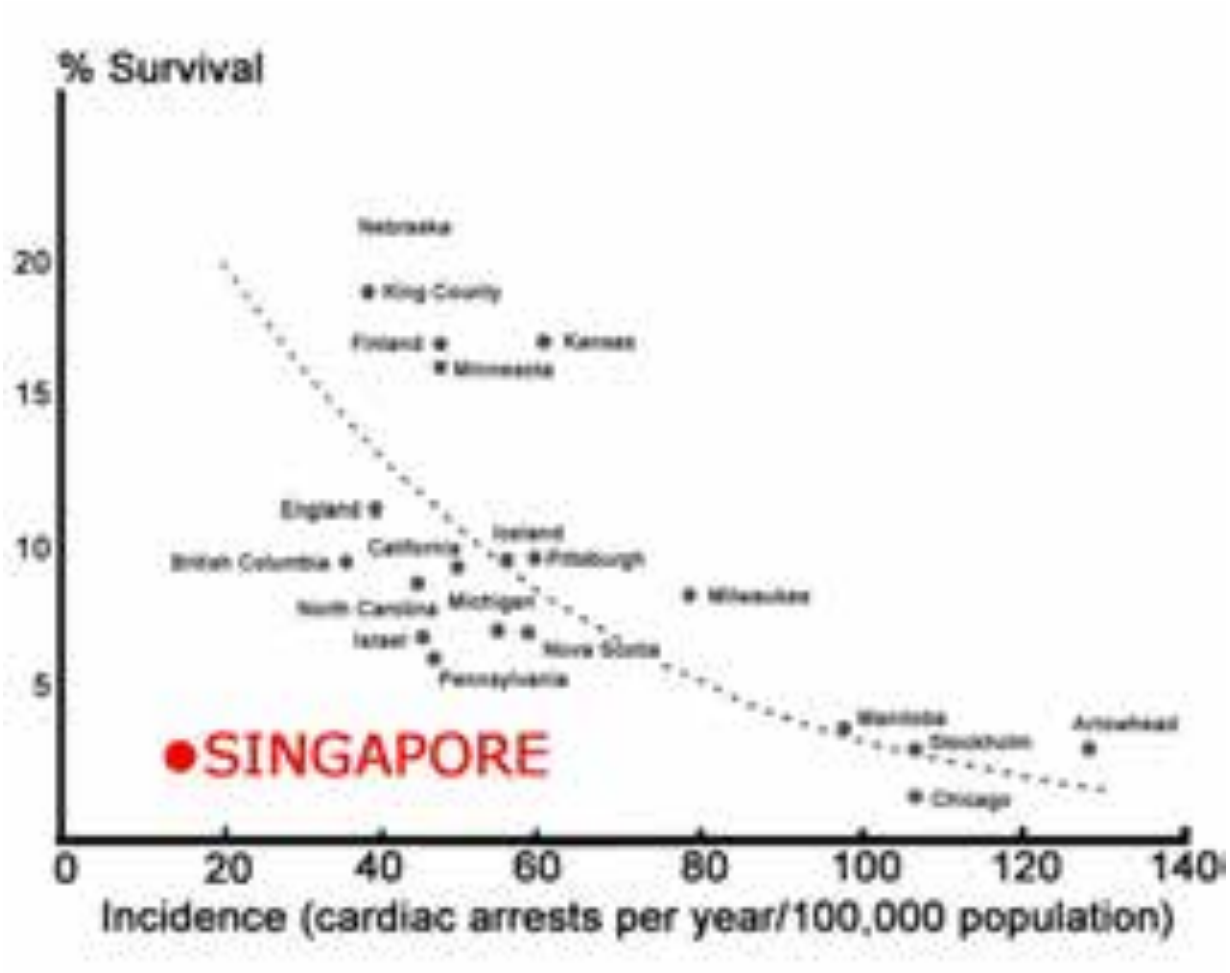
CARE

- CARE Phase 1
  - Epidemiology of out of hospital cardiac arrests in Singapore
- CARE Phase 2
  - Introduction advanced life support with firstly the use of IV adrenaline
- CARE Phase 3
  - Geographic-Time Distribution of Ambulance Calls in Singapore: Utility of Geographic Information Systems in Ambulance Deployment
- PIVOT
  - Randomized, Double-blind, Multicenter trial comparing IV adrenaline and IV vasopressin in prehospital cardiac arrest

CARE Phase 1

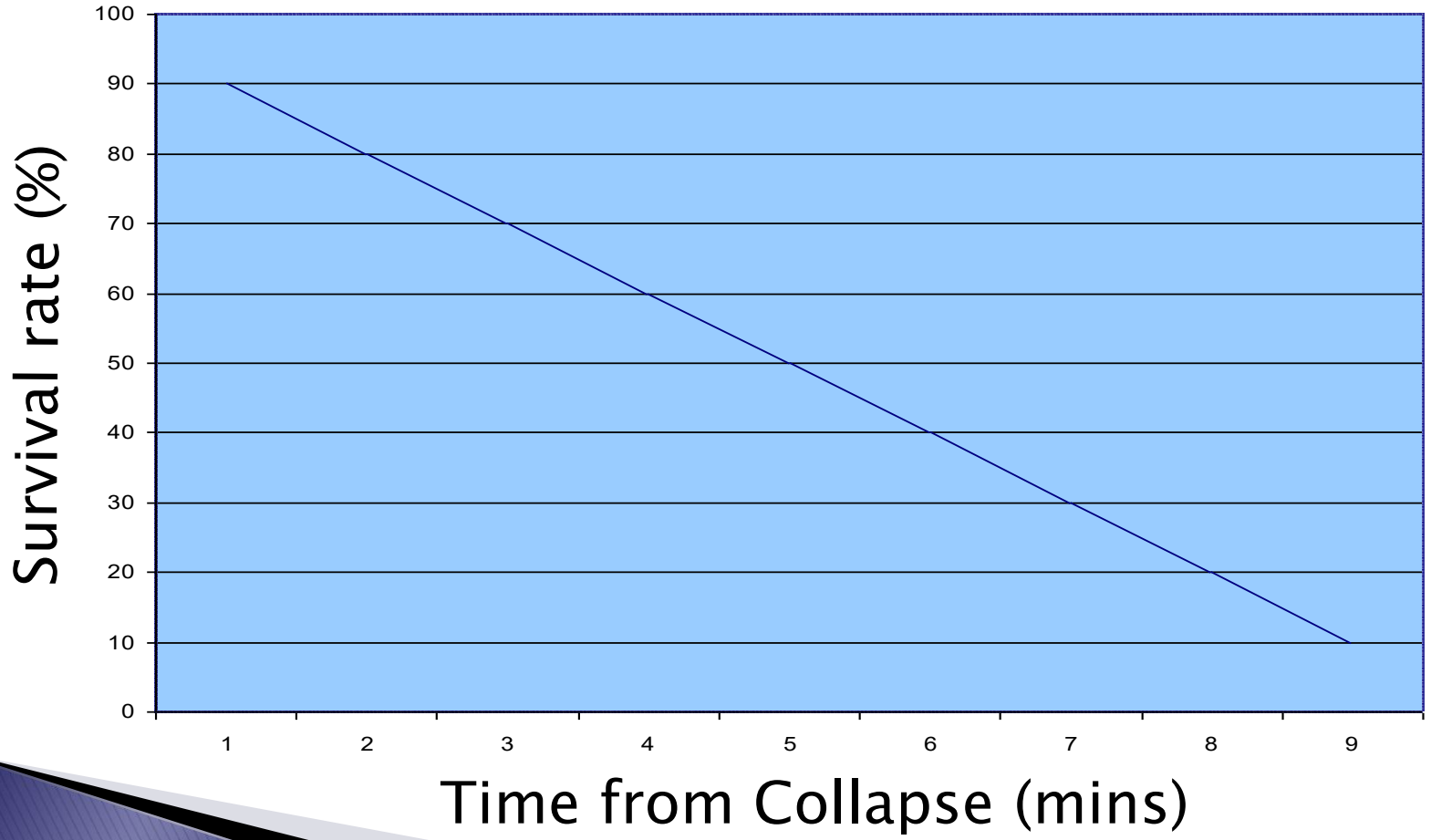
- Period of study: 1 Oct 2001 to 30 Apr 2002
- Number of Cases Recruited: 599
- Number of Ineligible Cases: 51; of which
  - 8: Conveyed by Private Ambulance
  - 12: Not OHCA
  - 31: Traumatic Arrests
- Subjects available for analysis: 500
  - 48 missing or incomplete data

Care 1 Discussion



Care 1 Discussion

↓Time is Life



Care 2

- Survival Outcomes with the Introduction of Intravenous Adrenaline in the Management of Out-of-Hospital Cardiac Arrest

Care 2 objectives

- To assess the effect of introducing intravenous Adrenaline on the survival outcomes of pre-hospital cardiac arrest in a system that did not previously use intravenous drugs
- Specific outcomes :

- survival to discharge
- survival to hospital admission
- return of spontaneous circulation
- functional status on discharge.

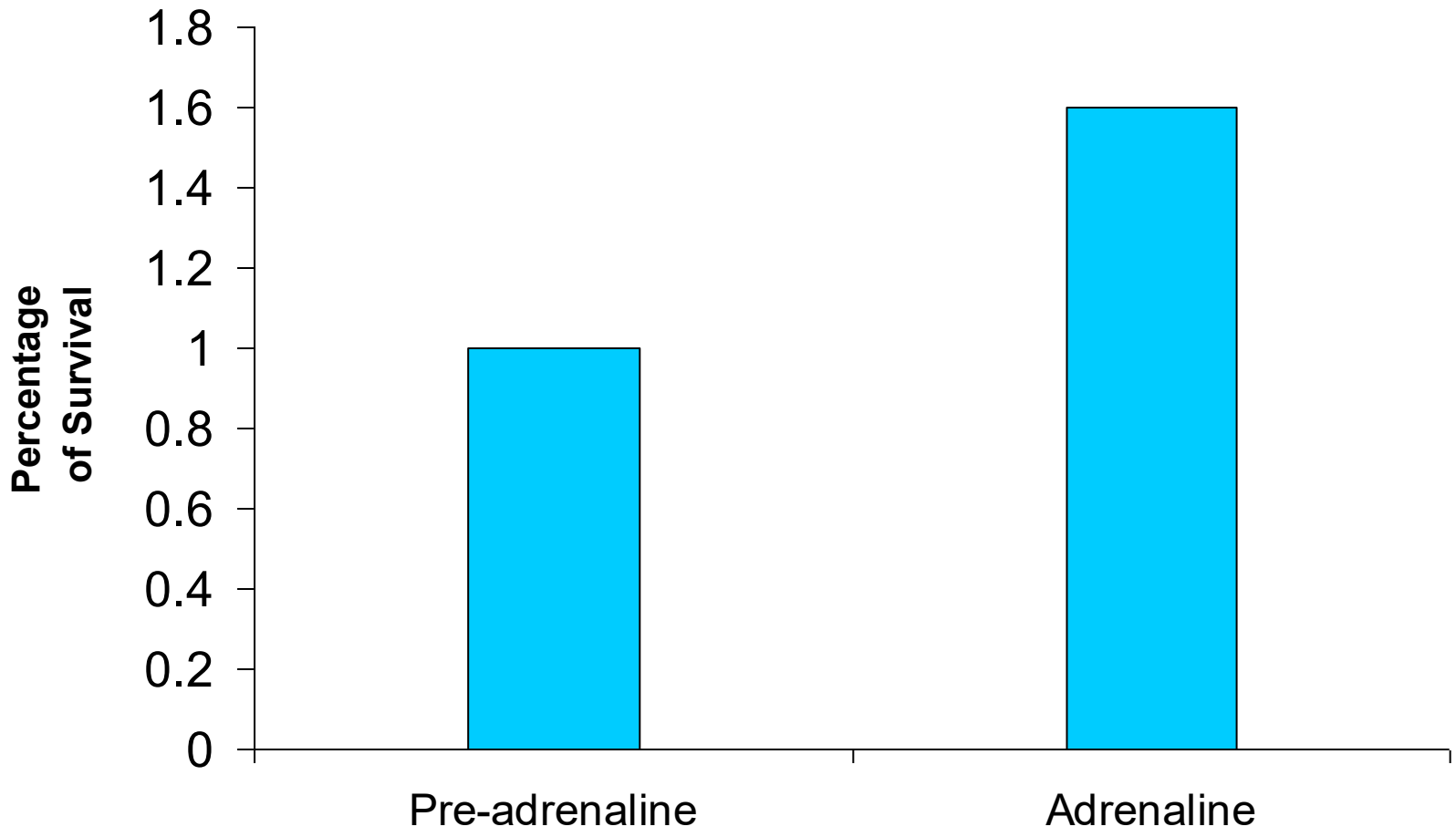
Care 2 Methodology

- Prospective, observational, before-after clinical trial
- During phase 2, intravenous adrenaline was introduced in the treatment protocols of all OHCA patients conveyed by the SCDF ambulance service
- Exclusion criteria:
  - Patients of ages <8 years
  - Traumatic cardiac arrest
  - 'Obviously dead' as defined by the presence of decomposition, rigor mortis or dependant lividity.

Care 2 Methodology

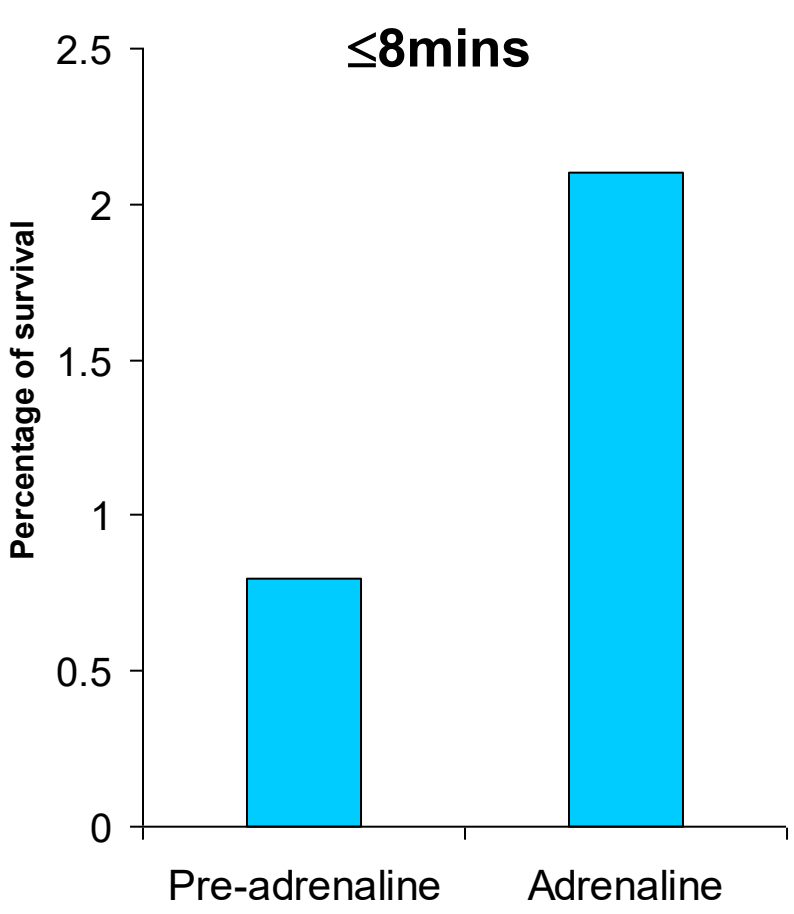
- Treatment followed strict protocols approved by MOH and MAC
- Paramedic training in intravenous cannulation, intravenous drug administration
- 2 attempts or 2 minutes for successful intravenous (IV) placement at scene
- If IV placement was unsuccessful, not to delay transport any further but to transport
- Another 2 IV attempts allowed in the ambulance en route
- Only 1 dose of prediluted adrenaline 1:10 000 in 10 mls solution given

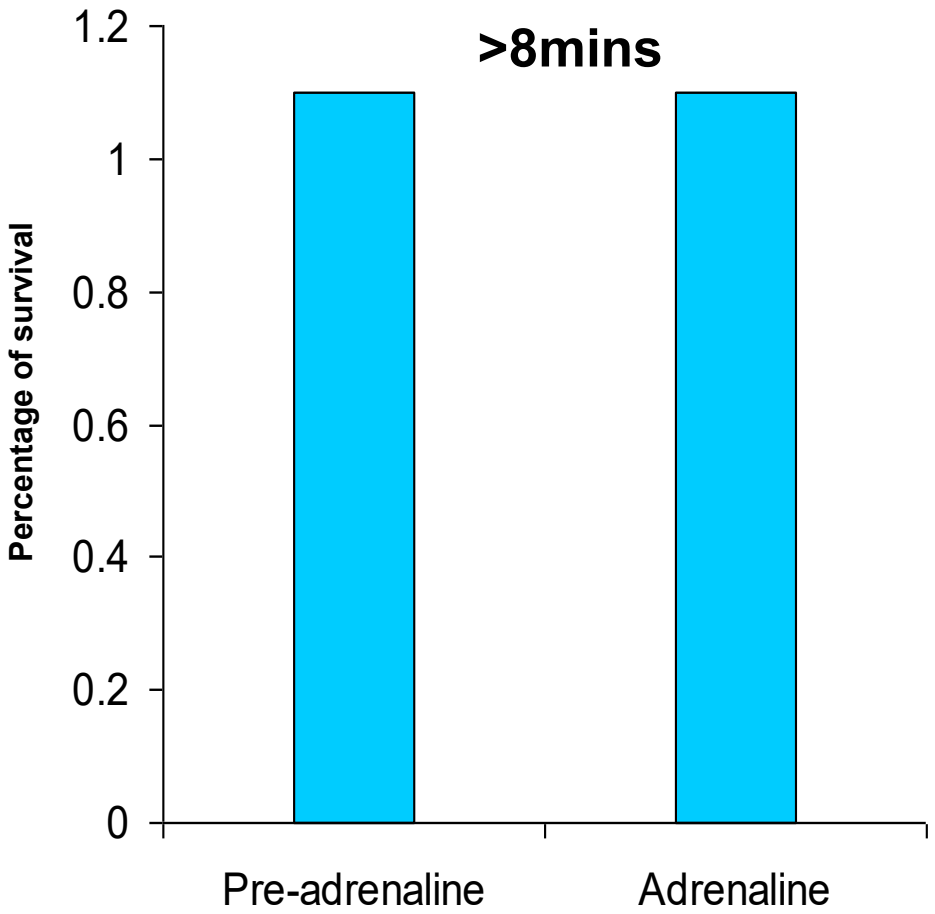
Survival to Discharge



OR = 4.93 (1.32,18.50)

Survival to Discharge





Care 2 Conclusions

- We found a modest survival benefit with the introduction of intravenous adrenaline to an EMS system.
- There is a trend to suggest increased benefit if EMS response times can be reduced to <8 mins
- More research is needed into the effects of medications in cardiac arrest

CARE Phase 3

- Geographic-Time Distribution of Ambulance Calls in Singapore: Utility of Geographic Information Systems in Ambulance Deployment

CARE 3 Objectives

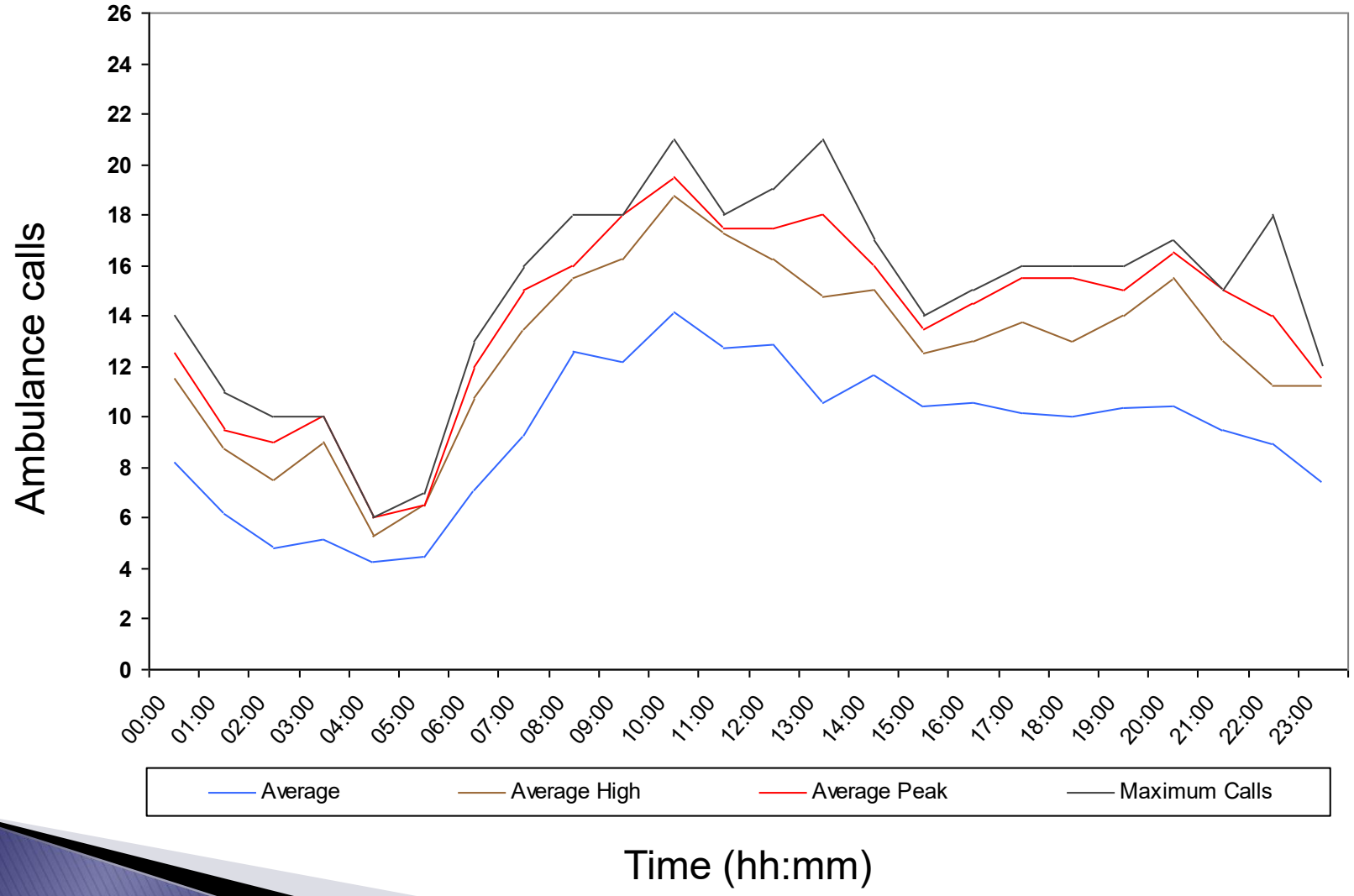
- Pre-hospital ambulance calls are not random events, but occur in patterns and trends that are related to movement patterns of people, as well as geographical epidemiology of the population.
- This study describes the geographic-time epidemiology of ambulance calls in a large urban city and conducts a time demand analysis.
- This will facilitate a Systems Status Plan for deployment of ambulances based on the most cost effective deployment strategy.

CARE 3 Methodology

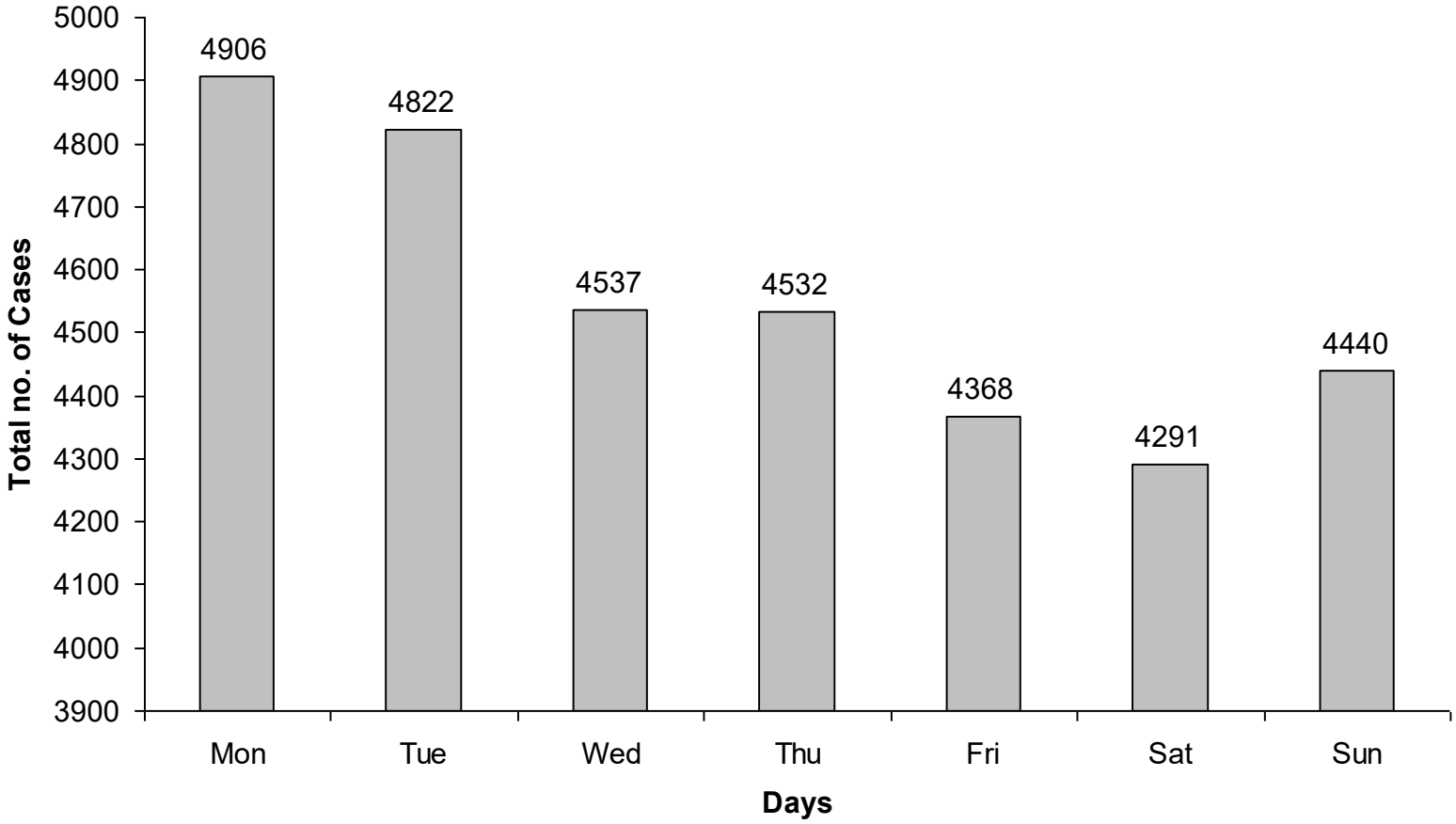
- An observational prospective study looking at the geographic-time epidemiology of all ambulance calls in Singapore.
- Patient characteristics, call circumstances, EMS response times and traffic conditions were recorded
- Geographic location of ambulance calls (including postal code) and type of location (house, office, public place, shopping mall, school etc)

Geographical distribution of ambulance calls for Mondays

Distribution of ambulance calls by hour of the day (Mondays)

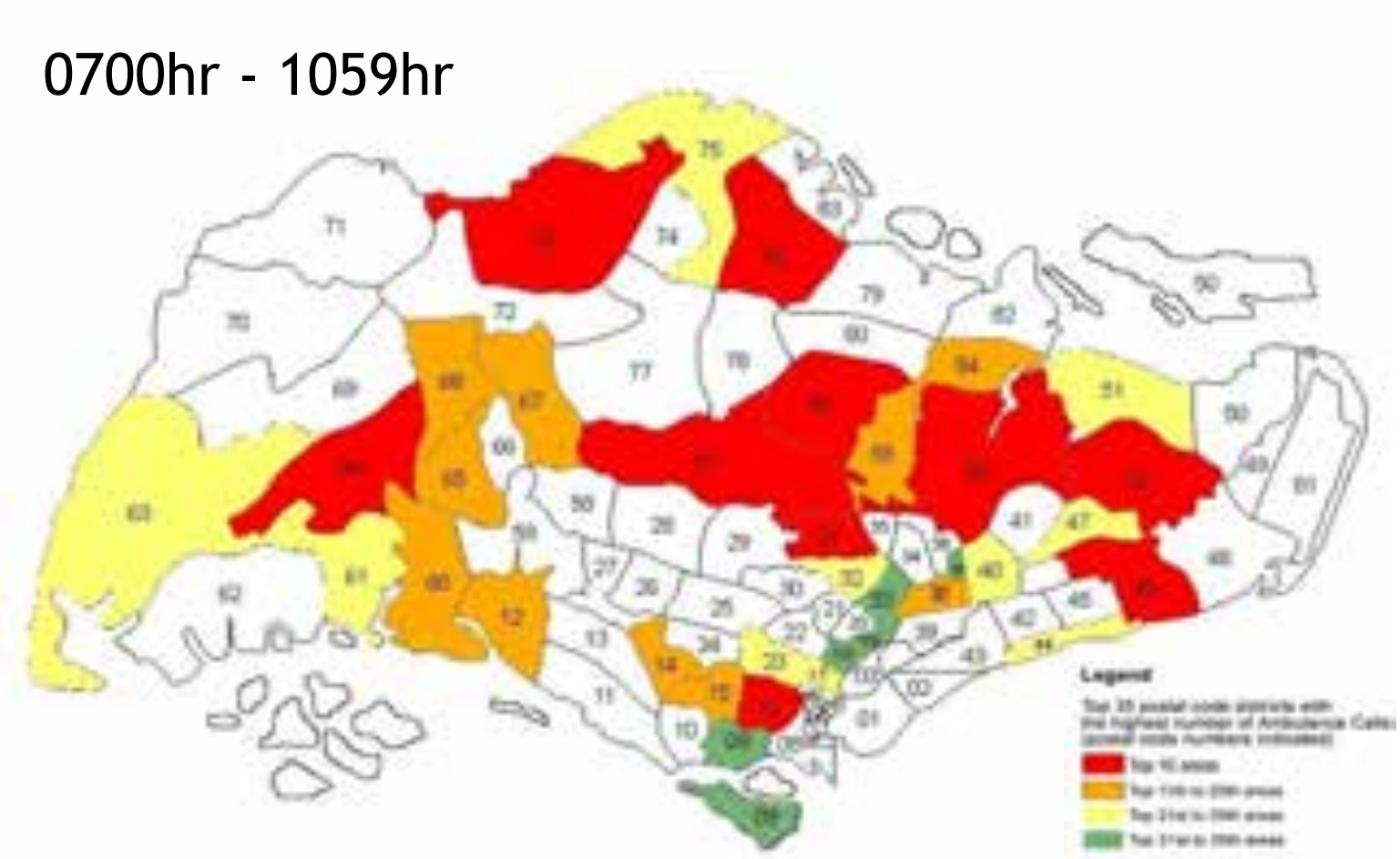


Number of ambulance calls by day



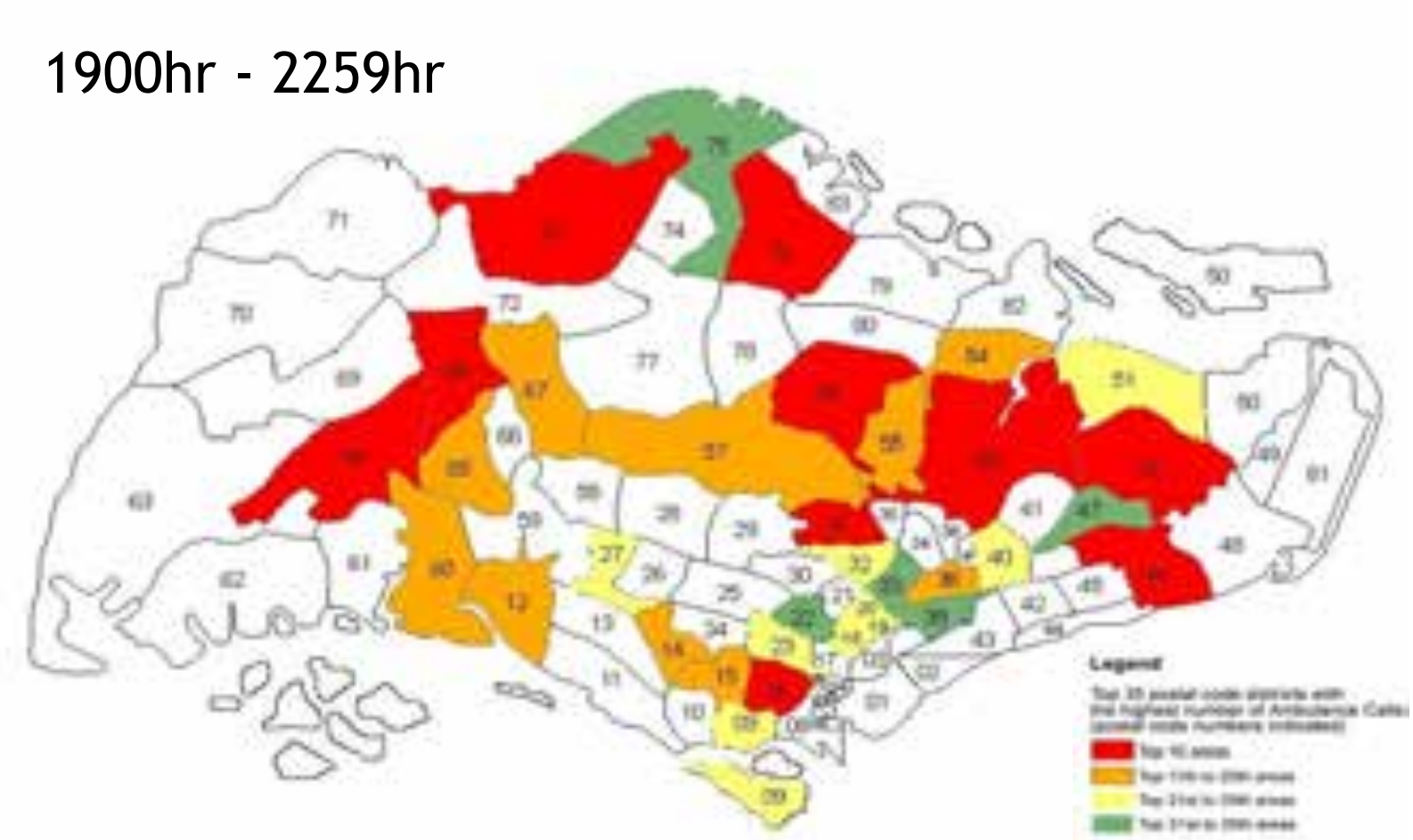
Top 35 postal code districts with the highest number of ambulance calls by time periods

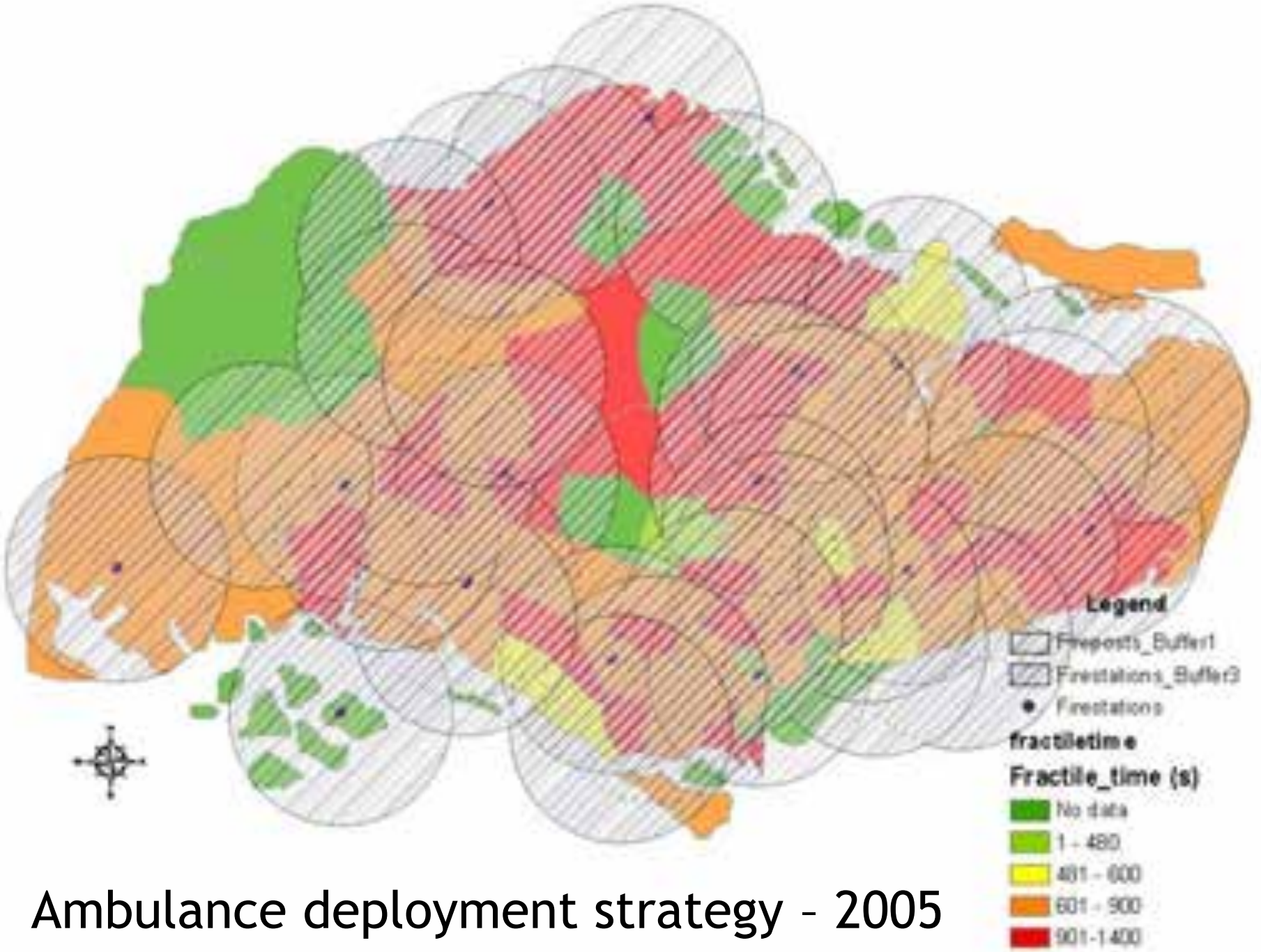
0700hr - 1059hr



Top 35 postal code districts with the highest number of ambulance calls by time periods

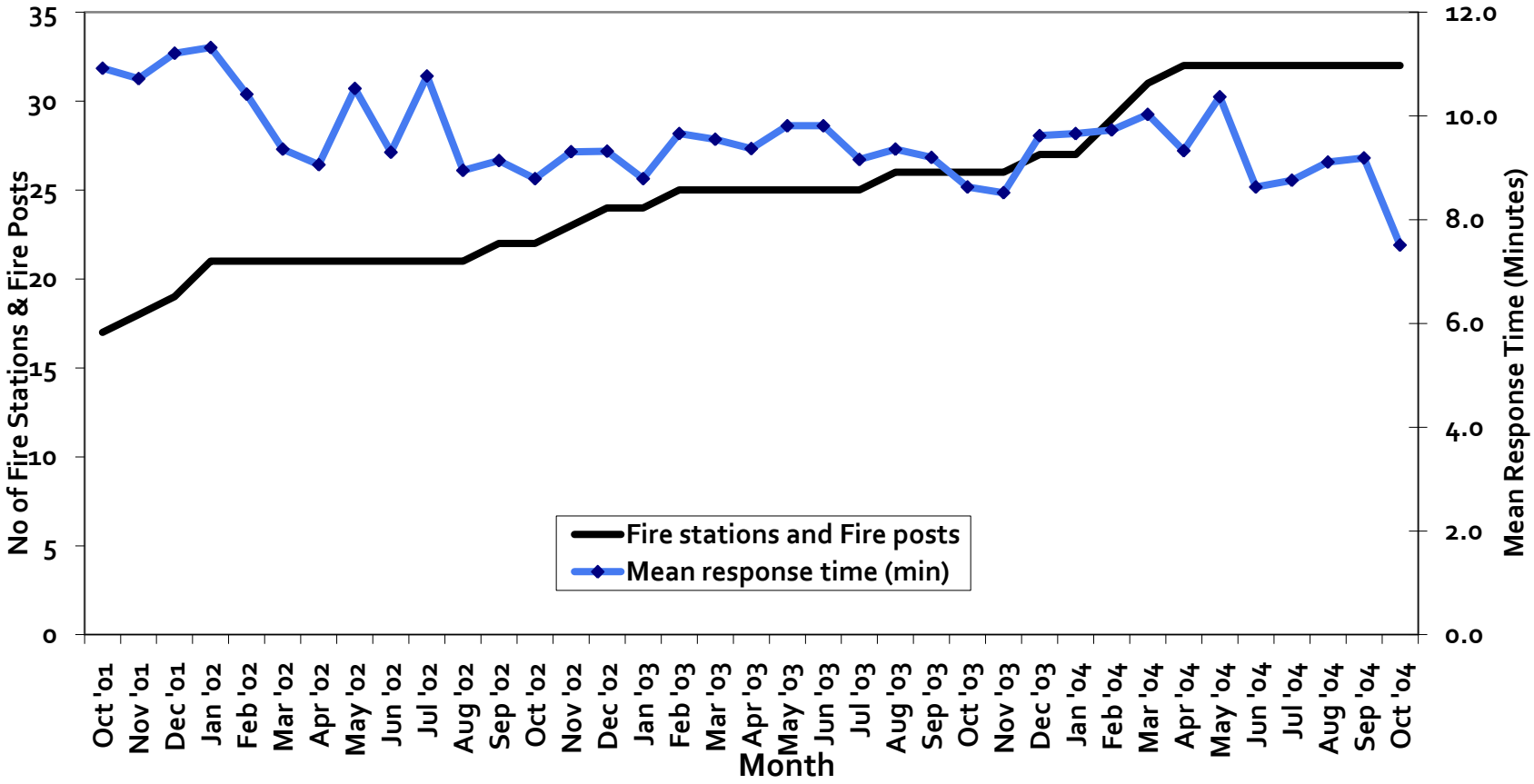
1900hr - 2259hr





Ambulance deployment strategy – 2005

Results – Mean response time and number of fire stations & fire posts by month



CARE 3 Discussion and conclusions

- Ambulance calls highest in the suburban town centers of the Eastern and Southern parts of the country
- Twice as many ambulance calls occurred during the day (0701h to 1900h) compared to night (1901h to 0700h)
- General time-of-day pattern was stable irrespective of day of week
- Top 35 districts with the highest call volumes can form the basis for ambulance deployment plans

CARE 3 Conclusions

- **We found a definite geographical distribution pattern of ambulance calls**
- **Mobile ambulance deployment pattern would result in shorter response times**
- **This study demonstrates the utility of GIS with dispatch demand analysis and has implications for maximizing effectiveness of ambulance deployment**

Future developments

- Developing a system status plan for mobile ambulance deployment, based on real time data of ambulance demand
- We intend to measure the effects on ambulance response times
- A larger sample size is also planned to measure the effect on outcomes such as survival to discharge.

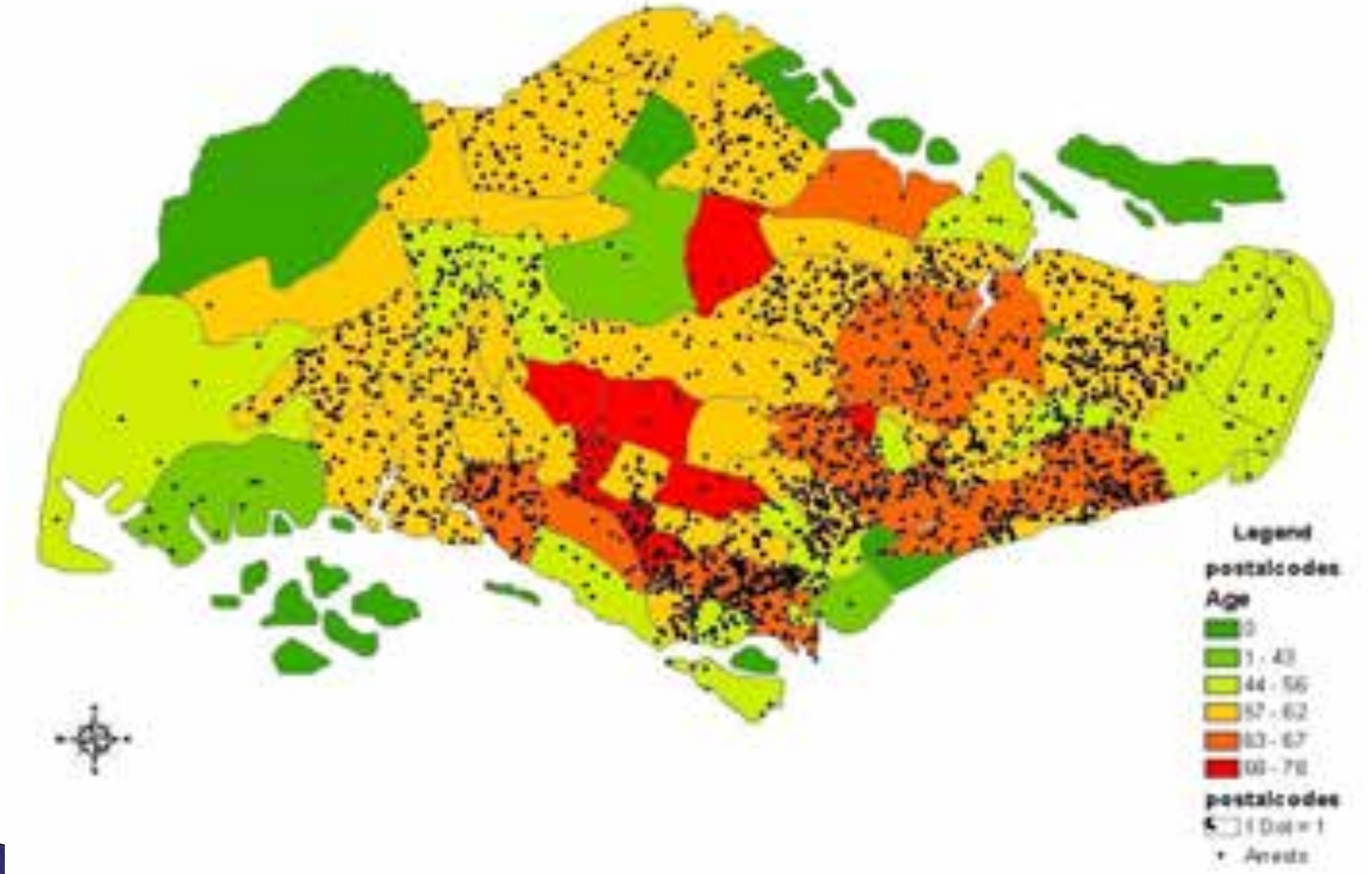
PADS

- What is the Geographic-Time Distribution of Cardiac Arrests in Singapore?
- Describe the geographic epidemiology of prehospital cardiac arrest in Singapore
- Assess the potential for deployment of a Public Access Defibrillation program

PADS- Methods

- Observational prospective study
- Looking at the geographic location of pre-hospital cardiac arrest in Singapore
- Inclusion criteria: all patients with OHCA presented to Eds
- Period of study: **1 Oct 2001 to 14 Oct 2004**
- Number of Cases : **2428**
- Location of cardiac arrests was spot mapped using Geographic Information Systems (GIS) technology (ArcGIS9, ESRI)

Mean age distribution of cardiac arrests



PADS Conclusions

- We found a definite geographical distribution pattern of cardiac arrest
- Has implications for targeted CPR training, AED placement and ambulance deployment
- Results may enable us to derive the most cost effective AED deployment strategy by type and geography of location

CCR vs CPR

- To compare the outcomes of cardiac arrest patients in the Cardiac Arrest and Resuscitation Epidemiology (CARE) study who had received CC-CPR, standard CPR or no bystander CPR.

- Primary outcome
  - Survival to hospital discharge

CCR vs CPR Methods

- Prospective, multi-phase, observational study
- Involved all out-of-hospital cardiac arrest patients attended by EMS providers.
- Technique of bystander CPR was reported by paramedics who arrived at the scene.
- LIFEPAK 12 was used to capture ECG recordings.
- EMS timings were automatically recorded by the computerized central dispatch system and ambulance AEDs.

CCR vs CPR Methodology

- Period of study: 1 Oct 2001 to 14 Oct 2004
- Number of Cases : 2428
  - No bystander CPR:1695
  - Bystander CPR: 478

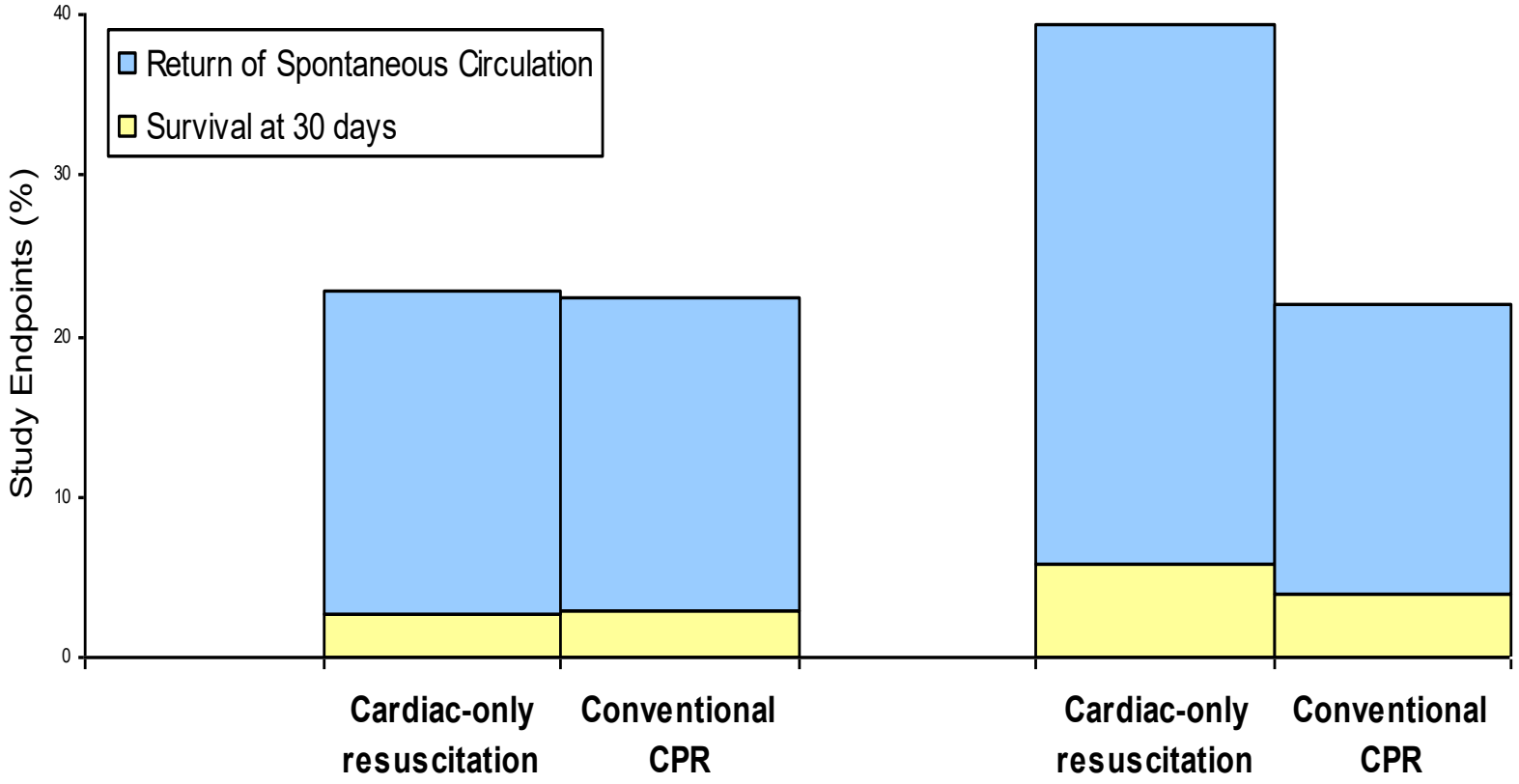
CCR vs CPR Results

Characteristics	Chest Compression (n=154)	Ventilation and Compression (n=287)	p value
Defibrillated (%)	57 (37.0)	111 (38.7)	0.732
Call receipt to vehicle stops, min (SD)	9.4 (4.6)	10.2 (4.5)	0.103
Call receipt to arrive patient's side, min (SD)			0.190
Vehicle arrive patient's side to leave location, min (SD)	9.6 (4.1)	9.0 (3.9)	0.133
Vehicle leave location to arrive hospital, min (SD)	11.5 (6.0)	11.9 (5.7)	0.553
Past medical history (n=381; %)			
Heart disease	63 (49.2)	91 (36.0)	0.013
Diabetes	32 (25.0)	59 (23.3)	0.716
Hypertension	49 (38.3)	97 (38.3)	0.991
Stroke	11 (8.6)	21 (8.3)	0.922
Cancer	6 (4.7)	9 (3.6)	0.592
Others	24 (18.8)	68 (26.9)	0.080
Return of Spontaneous Circulation	27 (17.5)	48 (16.7)	0.984
Survival to Admission	12 (7.8)	30 (10.5)	0.786
Survival to Discharge	4 (2.6)	8 (2.8)	1.000

Patients who survived to hospital discharge or 30 days post arrest

	No bystander Resuscitation (%)	Ventilation & Chest Compression (%)	Chest Compression only (%)	Ventilation and chest Compression versus no bystander resuscitation	Chest Compression only versus no bystander resuscitation	Chest Compression only versus both ventilation and chest compression
				OR (95% CI)		
All patients	9/1695 (0.5)	8/287 (2.8)	4/154 (2.6)	5.4 (2.1 - 14.0)	5.0 (1.5 - 16.4)	0.9 (0.3 - 3.1)
Cause						
Cardiac	5/1122 (0.4)	5/202 (2.5)	3/120 (2.5)	5.7 (1.6 - 19.8)	5.7 (1.4 - 24.3)	1.0 (0.2 - 4.3)
Non-cardiac	4/573 (0.7)	3/85 (3.5)	1/34 (2.9)	5.2 (1.1 - 23.7)	4.3 (0.5 - 39.7)	0.8 (0.1 - 8.3)
Initial Rhythm						
VF/VT	3/234 (1.3)	4/101 (4.0)	3/51 (5.9)	3.2 (0.7 - 14.5)	4.8 (0.9 - 24.6)	1.5 (0.3 - 7.0)
Asystole	1/906 (0.1)	0/104 (0.0)	1/70 (1.4)	NA	13.1 (0.8 - 212.0)	NA
PEA	1/386 (0.3)	1/62 (1.6)	0/31 (0.0)	NA	NA	NA
Response time						
≤ 8 min	4/665 (0.6)	4/96 (4.2)	2/69 (2.9)	7.2 (1.8 - 29.2)	4.9 (0.9 - 27.4)	0.7 (0.1 - 3.9)
> 8 min	1/898 (0.1)	2/179 (1.1)	2/85 (2.4)	10.1 (0.9 - 112.4)	21.6 (1.9 - 240.9)	2.1 (0.3 - 15.4)

ROSC and Survival to Discharge for Chest Compression Only and Standard CPR by initial rhythm



Whole cohort

VF/VT as initial cardiac rhythm

Conclusions

- We found that patients were more likely to survive with any form of bystander CPR than without.
- There was no difference in survival to discharge between CC-CPR and standard CPR.
- This provides additional evidence for the importance of chest compressions, whether with or without ventilations.

Current ongoing research

A Prospective Clinical Study Comparing Controlled Therapeutic Hypothermia Post-Cardiac Arrest Using External and Internal Cooling to Standard Intensive Care Unit Therapy (Hypothermia Study)

Objectives

- Observational data on conventional post-resuscitation care treatment (Phase 1)
- Randomised, controlled comparison between internal and external methods of inducing hypothermia (Phase 2)
- Before-after, intention-to-treat type analysis

Hypothermia Methodology

Inclusion criteria

- Sustained return of spontaneous circulation (ROSC) after cardiac arrest, for more than 30 min.
- Patients aged between 18 to 80 years.
- Females aged below 50 years with a negative pregnancy test.
- Patients who are hemodynamically stable, with a systolic BP > 90 mmHg with or without inotropic support.
- Patients comatose or unresponsive post-resuscitation.

Exclusion criteria

- Hypotension despite fluid and/or vasopressor support.
- Positive pregnancy test in women.
- Premorbid and status bedbound and uncommunicative.
- Traumatic arrest

Hypothermia Methodology

- Patients on the hypothermia protocol were cooled to a target temperature of 34 degrees Celsius.
- Continuous temperature monitoring using a Foley catheter with a temperature sensor.
- After 24 hours at 34 degrees Celsius, the patient will be rewarmed passively by increasing target temperature by 1 degree every 4 hours over 12 hours.