



St John

Here for Life

Out-of-Hospital Cardiac Arrest Registry

Annual Report 2014/15





Clinical Audit and Research

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Case study: Surviving cardiac arrest

Invercargill man grateful for second chance thanks to rapid community response

Gary Deuchrass was enjoying the start of his regular weekend work out at Invercargill's YMCA one Sunday in August. He had just completed five minutes on the treadmill when he suddenly felt dizzy and passed out.

The 52-year-old's heart had stopped beating and he was in cardiac arrest. If it were not for the quick actions and intervention of his fellow gym goers, Gary might not be here today to tell the tale of his recovery.

The second of August started out unremarkably for off duty police officer Jason Gordon until he heard the thud of Gary hitting the ground and knew something was seriously wrong. Fortunately Constable Gordon is trained in first aid so early recognition of cardiac arrest and his CPR skills immediately kicked in. He took control of the scene until emergency services arrived, telling YMCA gym instructor Suyash Pawar to grab the defibrillator stationed at reception while he initiated CPR and another gym patron rang 111.

The YMCA's Lifepak defibrillator had been installed by the Invercargill Council as part of a community initiative and was applied to Gary's chest within a minute of his collapse. The speed and capability with which this happened immediately increased Gary's chances of survival by 40 per cent.

Paramedic Matt Schultz was one of the first ambulance crew on scene, arriving within three minutes. Matt was impressed with the management, collaboration and speed of the community response—the patient had already received two shocks to his heart.

"This was one of those rare occasions where everything lined



Left to right: St John Paramedic Matt Schultz, cardiac arrest survivor Gary Deuchrass, Constable Jason Gordon and YMCA gym instructor Suyash Pawar at Invercargill YMCA

up in the 'chain of survival'—from early recognition of Gary's cardiac arrest, applying early CPR and defibrillation through to advanced life support provided by myself and my two St John colleagues before transportation to hospital," says Matt.

THE 52 YEAR-OLD'S HEART HAD STOPPED BEATING AND HE WAS IN CARDIAC ARREST

"It's a real buzz to be involved in such a time-critical and life-threatening situation and to see a positive outcome because things went well from the get-go—starting with bystanders having the confidence to help."

Gary's survival is the perfect example of community collaboration and resilience when

people are trained in first aid and CPR skills and have access to lifesaving equipment.

YMCA CEO Ivan Hodgetts says the defibrillator is an important resource, "not just for our staff and patrons but for the entire community," and YMCA staff have regular first aid training.

St John would like to see more defibrillators available in local towns and neighbourhoods and more people initiating care as emergency services make their way to the scene. Vital seconds matter and early intervention with a defibrillator increases that patient's chances of survival by 40 per cent.

Gary is now back at work as a power systems technician and is grateful for his second chance. Completing a first aid course every six months as part of his job now has first-hand significance. ■

From the Chief Executive Officer



Every day in New Zealand approximately five people are treated for an out-of-hospital cardiac arrest.

From the moment they go into cardiac arrest, there are many individuals who contribute to their survival—from members of the public who witness the event and perform cardiopulmonary resuscitation (CPR) or use an automated external defibrillator (AED), to 111 call handlers, ambulance personnel (including volunteers), co-responders such as the New Zealand Fire Service and hospital personnel.

Benchmarking outcomes from OHCA is one of the key measures of clinical quality of an emergency ambulance service and is fundamental to improving survival rates. To provide the best evidence-based patient care, St John measures and compares our patient outcomes against our previous data and the performance of other ambulance services, and uses the resulting clinical insights to help make continual improvements. As both the provider of ambulance services and a number of community education programmes, St John is in a unique position to improve a number of aspects in the chain of survival.

This year's report indicates that our treatment of patients in cardiac arrest continues to be of a high standard, with survival to hospital discharge holding steady and comparing favourably internationally. The data presented gives us a strong evidence base for reviewing our practices and considering clinical improvements to the way we treat our patients, with the ultimate goal of ensuring that over time more people survive cardiac arrest. ■

Peter Bradley
Chief Executive Officer

THIS YEAR'S REPORT INDICATES THAT OUR TREATMENT OF PATIENTS IN CARDIAC ARREST CONTINUES TO BE OF A HIGH STANDARD

The publication of the St John OHCA annual report enables this benchmarking to take place and I am pleased to introduce our second report, which analyses a full year's worth of data.

From the Director of Clinical Operations



St John New Zealand is delighted to publish its second annual out-of-hospital cardiac arrest report.

Our first report, published in October 2014, examined nine months of clinical data. This report is the first analysis St John has undertaken of a full year dataset. It provides another opportunity for St John to benchmark ourselves with other similar services internationally.

Perhaps more importantly, the publication of our second OHCA report enables St John to compare our own results against previous performance as part of our journey to improve patient outcomes.

St John is in an influential position to impact health promotion and public education and link this to the advancing skills and technology that our ambulance clinicians use to treat our patients 24/7.

This journey starts with our St John in Schools programme and St John Youth where we educate youngsters on how to call for help swiftly and perform CPR. Our public first aid training reaches out to many communities and with the support of our newly appointed Māori Pou Takawaenga (liaison officers) we are reaching even more people.

Thanks to the generous support of our partner ASB, which has installed AEDs in its branches nationwide, we have more public defibrillators available.

These initiatives, combined with evidence-based research and the development of more sophisticated clinical pathways, give us the means to greatly improve our population's chances of survival from cardiac arrest.

It is our hope the data and insights within this report help inform those in our communities who play a part in improving patient clinical outcomes while providing a basis for how we can make a real difference together. ■

A handwritten signature in black ink that reads 'Norma'.

Norma Lane
Director of Clinical Operations

The St John emergency ambulance service

St John is New Zealand's largest emergency ambulance service (EAS) serving around four million people or approximately 90% of the population.

The service operates across 97% of New Zealand's geographical area while Wellington Free Ambulance services the Wellington and Wairarapa regions.

The organisation calls on more than 1,600 paid and over 3,300 volunteer ambulance officers to provide care to the 425,000 patients treated and transported each year. Ambulance officers in New Zealand may be vocationally trained (National Diploma, NZQA Level 4–6), hold a three year Bachelor of Health Science degree in paramedicine or hold post-graduate qualifications in advanced resuscitation. St John ambulance officers, both paid and volunteer, are supported through ongoing clinical education.

In an emergency New Zealanders dial 111 and are directed by telecommunications company Spark to one of three emergency agencies. Every day around 1,200 of these calls are for an ambulance. St John owns and runs the 111 Clinical Control Centres in Auckland and Christchurch and helps run a third in Wellington, in a joint venture with Wellington Free Ambulance.

Responding to a cardiac arrest

When an emergency ambulance call comes in, St John call handlers use the medical priority dispatch system (MPDS) to triage calls and determine the appropriate level of response to a call. A colour coded response system is used, based on international best practice.

An immediately life threatening call, such as a cardiac arrest, is allocated a 'purple' response, takes precedence over all other calls and the closest responder is immediately dispatched. This may be an emergency ambulance or any other co-responder including the St John Patient Transfer Service, New Zealand Fire Service, local first response groups or Primary Response in Medical Emergencies (PRIME) doctors and nurses. An intensive care paramedic qualified in advanced life support is also sent to all suspected cardiac arrests, when available.

For a suspected cardiac arrest the St John call handler instructs the caller to use an AED if available and guides them through the process of performing CPR.

Once ambulance officers reach the patient, they may continue the resuscitation attempt. Depending on the qualification of the responding personnel, they

may also provide advanced life support such as advanced airway management, drug therapy, physiologic monitoring and post-cardiac arrest care.

A CARDIAC ARREST IS ALLOCATED A 'PURPLE' RESPONSE AND THE CLOSEST RESPONDER IS IMMEDIATELY DISPATCHED.

The cardiac arrest protocols used by ambulance officers on scene have been developed by the National Ambulance Sector Clinical Working Group¹. In situations where resuscitation is not feasible, or clearly not in the best interest of the patient, St John ambulance officers may elect not to start a resuscitation attempt. When a resuscitation attempt is underway, it may later be stopped by ambulance officers following the written protocols within the St John Clinical Procedures and Guidelines¹. ■



About this report

Cardiac arrest remains a considerable public health issue, with ischaemic heart disease being the second most prevalent cause of death in New Zealand².

Survival to hospital discharge rates for OHCA are highly variable internationally and can range from less than 4% to greater than 20%³. Benchmarking survival from OHCA is a key measure of the clinical quality of an EAS and fundamental to making improvements in OHCA survival⁴. Knowledge of New Zealand OHCA outcomes is a key driver to help identify and address areas for improvement in clinical care.

The data presented in this report is for all OHCA attended by the St John EAS in the period from 1 July 2014 to 30 June 2015. The previous year's report covered a nine month period, so this is the first time that a full year's data has been analysed. The data for this report was extracted from the registry on 8 October 2015.

The data is collated in the registry using a reporting template based on international definitions outlined in the Utstein style of reporting and the variables developed by the Australian Resuscitation Outcomes Consortium (Aus-ROC)⁵⁻⁷.

Where possible comparisons are drawn with Wellington Free Ambulance, Ambulance Victoria, London Ambulance Service, St John Ambulance Western Australia and King County Emergency Medical Services (EMS) in Washington USA⁸⁻¹². These services were selected as the definitions and collection variables that are used in the St John OHCA Registry are closely aligned with those used by these services.

The data presented in this report is aligned to enable comparisons with other services and primarily relates to events that were either 'attended' or where there was a 'resuscitation attempted' by St John EAS personnel. 'Attended' refers to all OHCA where St John EAS personnel were present regardless of whether or not a resuscitation attempt was made. 'Resuscitation attempted' refers only to those events where St John EAS personnel were present and an attempt at resuscitation was made. The outcomes of OHCA for international benchmarking compare median response time, return of spontaneous circulation (ROSC) sustained to handover at hospital (survived event) and discharged from hospital alive (survival to discharge).

Descriptive statistics were performed with statistical software

InStat (Graphpad, v3.10) and tests were chosen depending on whether the data fitted a normal distribution with equivalent variances in the standard deviation. Results were determined to be significant if $p < 0.05$.

All population figures in this report are derived from Statistics New Zealand population data using the online population tools or population tables¹³⁻¹⁶. The population figures provided are for the end of June 2014, with the population of the St John response area being 4,018,520.

Unless otherwise stated all analysis is inclusive of cardiac arrests witnessed by St John EAS personnel. If it is unrecorded whether the patient is a child or an adult then these events are assumed to be adults and are included in the adult category. ■



Executive summary



5 people a day

(approx) are treated for an out-of-hospital cardiac arrest in New Zealand
(more than **1,900 per year**)

33% female, 67% male



64%

of patients had bystander
CPR performed



The median time in which a St John
ambulance reaches a patient is
8 minutes in urban communities
and **11 minutes** in rural and
remote communities



73%

of events were co-responded
to and attended by the
New Zealand Fire Service



4%

of patients that had a
cardiac arrest in public were
defibrillated using public
access defibrillators



31%

of patients survived the
event (had a pulse on
arrival at hospital)



15% of patients survived to
hospital discharge

*Response to all-cause, out-of-hospital cardiac arrest in adults where
a resuscitation attempt was made by the responding EAS

Benchmarking executive summary

The outcomes of OHCA for international benchmarking compare the median response time, event survival rate and rate of survival to hospital discharge (Table 1).

A specifically selected subgroup of patients is also used to benchmark against other ambulance services. This subgroup is referred to as the “Utstein comparator group” by the

London Ambulance Service and requires the criteria outlined in Table 2 to be met.

When benchmarked against the other EAS for both all-cause events and for the selected subgroup, St John ranked third for hospital discharge status. Overall the outcomes for OHCA attended by St John are similar to those in the international community^{8; 9; 11; 12}. ■

Table 1: Outcomes for adults. Benchmarking all-cause events. (Resuscitation attempted events)

Ambulance Service	Data collection Period	Total events (resuscitation attempted)	Median response time (minutes)	Survived event (ROSC sustained to hospital handover)	Survived to hospital discharge
St John	1 July 2014 to 30 June 2015	1,996	8 (urban) 11 (rural and remote)	31%	15%
Wellington Free Ambulance ⁹	1 July 2014 to 30 June 2015	199	10 (urban) 13 (rural and remote)	41%	20%
Ambulance Victoria ¹⁰	1 July 2013 to 30 June 2014	2,679	8 (urban) 11 (rural and remote)	29%	10%
London Ambulance Service* ⁸	1 April 2013 to 31 March 2014	4,317	6 (urban) N/A (rural and remote)	31%	10%
St John Ambulance Western Australia ^{† 11}	1 July 2013 to 30 June 2014	761	6 (urban) N/A (rural and remote)	24%	9%
King County EMS ¹²	1 January 2013 to 31 December 2013	842	5 (urban) 10 (rural)	45%	19%

Table 2: Benchmarking survival to hospital discharge rates in adults where the arrest is bystander witnessed, has a shockable presenting rhythm and is of presumed cardiac aetiology. (Resuscitation attempted events)[‡]

Ambulance Service	Data collection Period	Survived to hospital discharge
St John	1 July 2014 to 30 June 2015	36%
Wellington Free Ambulance ⁹	1 July 2014 to 30 June 2015	53%
London Ambulance Service* ⁸	1 April 2013 to 31 March 2014	32%
St John Ambulance Western Australia ^{† 11}	1 July 2013 to 30 June 2014	24%
King County EMS ¹²	1 January 2013 to 31 December 2013	64%

* Data for London Ambulance Service is inclusive of children

† Data for St John Ambulance Western Australia is only available for urban events. All events n=1,595. Urban events n=761

‡ Data not available for Ambulance Victoria

The St John Out-of-Hospital Cardiac Arrest Registry

The St John OHCA Registry was formally established in September 2013. Since the registry was established, pre-hospital data for cardiac arrests attended by St John has been successfully captured for more than 7,000 patients.

The St John OHCA Registry is overseen by Dr Bridget Dicker, St John Clinical Research Fellow and Auckland University of Technology Research Associate.

Eligibility

St John captures data on all OHCA events attended by the St John EAS. St John defines a cardiac arrest as a patient who is unconscious and pulseless with either agonal breathing or no breathing.

Inclusion and exclusion criteria are described in Table 3 and Table 4.

Data capture

This report reflects data recorded between 1 July 2014 and 30 June 2015. The data is collated in the registry using a reporting template based on international definitions outlined in the Utstein style of reporting and the variables developed by the Australian Resuscitation Outcomes Consortium (Aus-ROC)⁵⁻⁷.

In the data collection process there are three separate points where data is acquired:

- > Computer Aided Dispatch (CAD) and supporting systems
- > On scene by the ambulance officers in attendance
- > District Health Board (DHB) patient outcome reporting.

Table 3: Inclusion criteria. (All of the following)

1	Patients of all ages who suffer a documented cardiac arrest
2	Occurs in New Zealand where St John or one of its participating co-responders is the primary treatment provider
3	> Patients of all ages who on arrival of the St John EAS are unconscious and pulseless with either agonal breathing or no breathing or > Patients of all ages who become unconscious and pulseless with either agonal breathing or no breathing in the presence of St John EAS personnel or > Patients who have a pulse on arrival of St John EAS personnel following successful bystander defibrillation.

Table 4: Exclusion criteria. (Any of the following)

1	Patients who suffer a cardiac arrest in a hospital facility where St John EAS may be in attendance but are not the primary treatment providers
2	Patients who suffer a cardiac arrest during an inter-hospital transfer where St John EAS may be providing transport but are not the primary treatment providers
3	Bystander suspected cardiac arrest where the patient is not in cardiac arrest on arrival of the St John EAS personnel, and where a successful attempt at defibrillation did not occur or no other evidence verifying a cardiac arrest state is present
4	Patients who suffer a cardiac arrest where Wellington Free Ambulance is the primary treatment provider

Computer aided dispatch

Patient and event details are collected by the Clinical Control Centre when a 111 call is received and an ambulance is dispatched, with data being entered into the computer aided dispatch (CAD) system. Data specifically related to cardiac arrest is obtained from the CAD system and transferred into the St John OHCA Registry.

On scene collection

Ambulance officers on scene attending a patient in cardiac arrest are required to record specific data. This is recorded on a paper cardiac arrest data form. The cardiac arrest data form and a copy of the patient care record are scanned and emailed, using a secure email server, to the cardiac arrest data officer.

DHB patient outcome data

Each patient who has been transported to hospital following a cardiac arrest has a record held by that DHB. Outcome data is requested from each DHB on a monthly basis by the cardiac arrest data officer.

Data quality

The registry is subject to quality improvement processes which involve continual auditing of existing data and updating of the registry entries as appropriate.

Reconciliation of paper cardiac arrest data forms with CAD system information enables the number of missing cardiac arrest event reports to be verified. During transcription from the paper data form into the registry, automated validation rules and error messages limit errors. A quality control audit of a random sample of 10% of cases is also undertaken every three months to validate the accuracy of data entry within the registry.

Registry reports are generated on a monthly and quarterly basis and these are analysed for variances in the numbers of cases and patient outcomes. These results are compared with international data from EAS that are similar to St John. In this report, comparison is made between Wellington Free Ambulance, Ambulance Victoria, London Ambulance Service, St John Ambulance Western Australia and King County EMS where applicable⁸⁻¹².

Missing data

Since the registry's inception there have been improvements made to the proportion of missing data. The overall fraction of missing pre-hospital data is now relatively low, which is reflective of an EAS culture that values continuous monitoring to improve patient outcomes.

There are three aspects that are monitored to quantify data completeness within the registry. The first is whether the event was recorded within the CAD system data set, the second whether or not a paper cardiac arrest data form was completed by the responding EAS crew and lastly whether or not all of the appropriate data fields were captured in full.

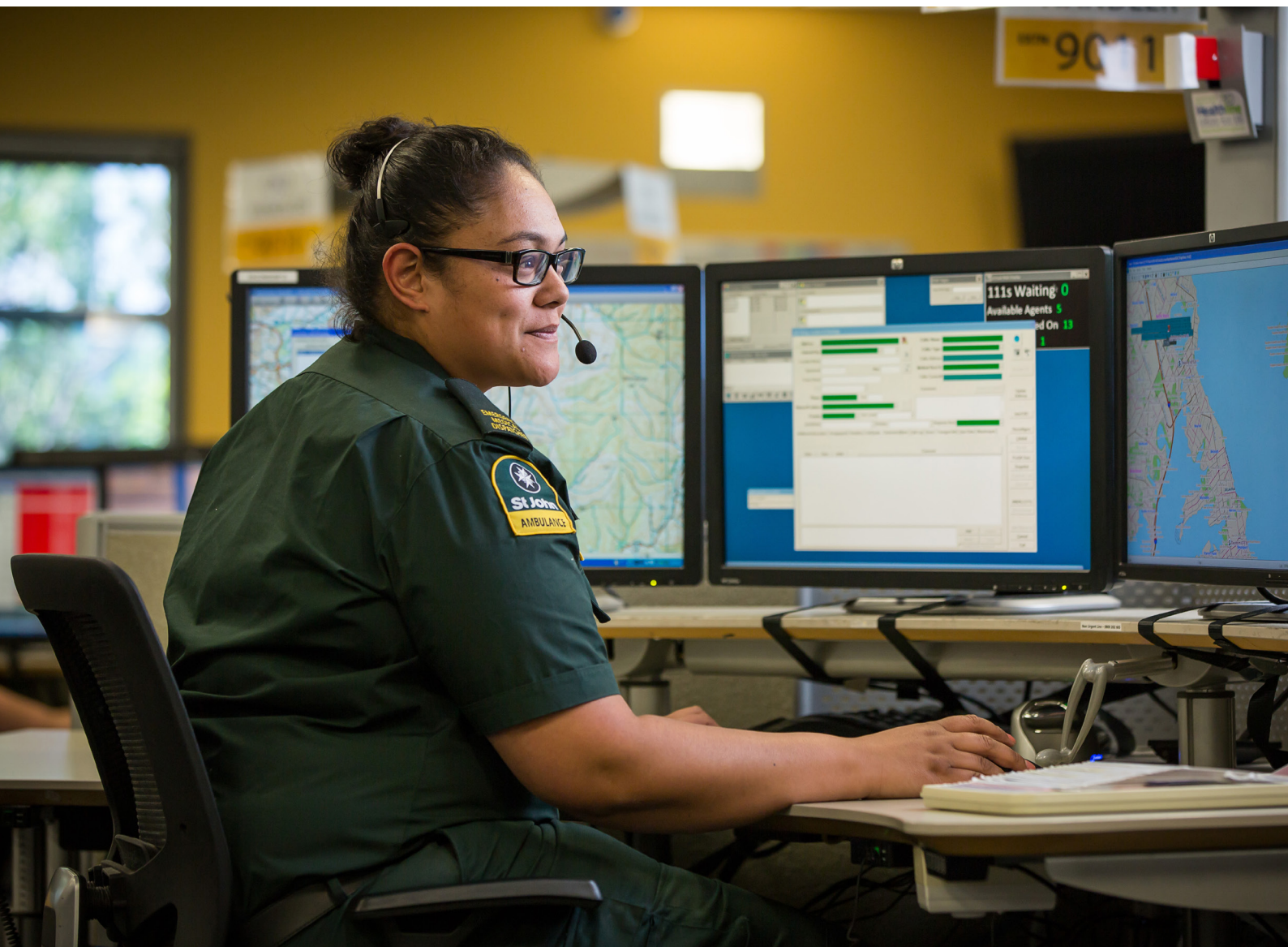
Almost all paper cardiac arrest data forms are completed in full by EAS personnel. However, for the ethnicity field the option exists for EAS crews to select "unknown" therefore ethnicity data is only fully established for 80% of entries. This result is not surprising as following cardiac arrest the patient is often unconscious and it may not be possible to accurately determine ethnicity.

Ethical review

The St John OHCA Registry has been approved by both the New Zealand Health and Disability Ethics Committee (Ethics reference 13/STH/192) and the Auckland University of Technology Ethics Committee (Ethics reference 13/367).

The registry is also subject to St John internal research governance processes that include a locality review and locality authorisation as per the Standard Operating Procedures for Health and Disability Ethics Committees.

The St John OHCA Registry is held on a secure server which requires active directory permissions. At no stage is data that could identify individual patients or individual hospitals released from this registry. ■



Incidence and demographics

Incidence of all events occurring in adults and children

St John is New Zealand's largest emergency ambulance service providing care to more than four million people or approximately 90% of New Zealand's population. Of this group of people, it is estimated that 865,600 (22%) are children younger than 16 years old¹³. In the period from 1 July 2014 to 30 June 2015 St John EAS attended 4,294 OHCA events of which 98% (n=4,188) were adults and 2% (n=106) were children.

The adult incidence rate for St John was 132.8 per 100,000 person-years compared to Ambulance Victoria and the London Ambulance Service that reported incidence rates of 120.8 and 118.0* per 100,000 person-years respectively in 2014^{8;10}. The incidence rate for adults recorded by St John for this reporting period is higher than that reported for the nine months prior (110 per 100,000 person-years). Possibilities for this apparent increase in rate are likely to be a combination of factors including increased data capture and increased accuracy in the 2014/15 period due to the longer time frame.

The incidence rate for children was 12.2 per 100,000 person-years. This is higher than the incidence rate of 7.7 per 100,000 person-years reported by Ambulance Victoria for the 2013 to 2014 period¹⁰. The finding of a higher incidence rate for children in New Zealand is in line with the difference reported in OECD Health Status Data (2011), which indicated infant mortality rates were 1.37 times higher in New Zealand than Australia¹⁸.

The low total number of events occurring in children (n=106) does however, contribute to a large variation in the reported incidence rate.

The proportion of OHCA events occurring in adults where resuscitation was attempted was 48% (n=1,996). This is similar to Ambulance Victoria and the London Ambulance Service where resuscitation was attempted in 48% and 44%[†] of OHCA events in adults respectively^{8;10}.

The adult incidence rate for events where resuscitation was attempted was 63.3 per 100,000 person-years, compared to Ambulance Victoria that reported an incidence rate of 58 per 100,000 person-years. In the OHCA events where resuscitation was withheld by St John EAS personnel, the main reason was that resuscitation was unlikely to be successful, such as a long period of time passing since the onset of cardiac arrest.

Demographics of adults

Of the OHCA events in adults attended by St John 67% of patients were male and 33% were female. The median age was significantly different between genders, with males having a lower median age at 66 years versus females at 71 years (p<0.0001) (Figure 1).

The overall standardised incidence rate for males was more than twice that for females at 146.4 versus 69.3 per 100,000 person-years. When standardised to individual age groups, males in all age groups had a higher incidence of OHCA per 100,000 person-years compared with females (Figure 2).

Demographics of children

The incidence of OHCA in children attended by St John is very low, with only 106 events being recorded over the one year reporting period. Due to the low incidence of cardiac arrest within the 12 month period, demographics were instead analysed on cumulative data for a 21 month period (n=188, 1 October 2013 to 30 June 2015). Over this period the median age was not significantly different between genders at nine months for males and 13 months for females (p=0.92). There was a higher proportion of cardiac arrest in boys (60%) compared to girls (40%). The higher incidence of cardiac arrest in boys aligns with the tenth New Zealand Child and Youth Mortality Review Report (2014), which showed a higher mortality rate for male children compared to female children (65.3% versus 34.7% of childhood deaths)¹⁹.

Over half of the cardiac arrests in this population were in patients aged younger than two. This is reflective of sudden unexpected death in infancy (SUDI) and respiratory arrest being significant contributing factors to OHCA in very young children¹⁹. Over the 21 month period, resuscitation was attempted in 72% of events (n=135), a proportionally higher percentage of attempts than for adults.

* Incidence for all ages calculated on a total population of London of 8,308,400¹⁷

† All ages; data not available for adult only

AGE DISTRIBUTION OF OHCA

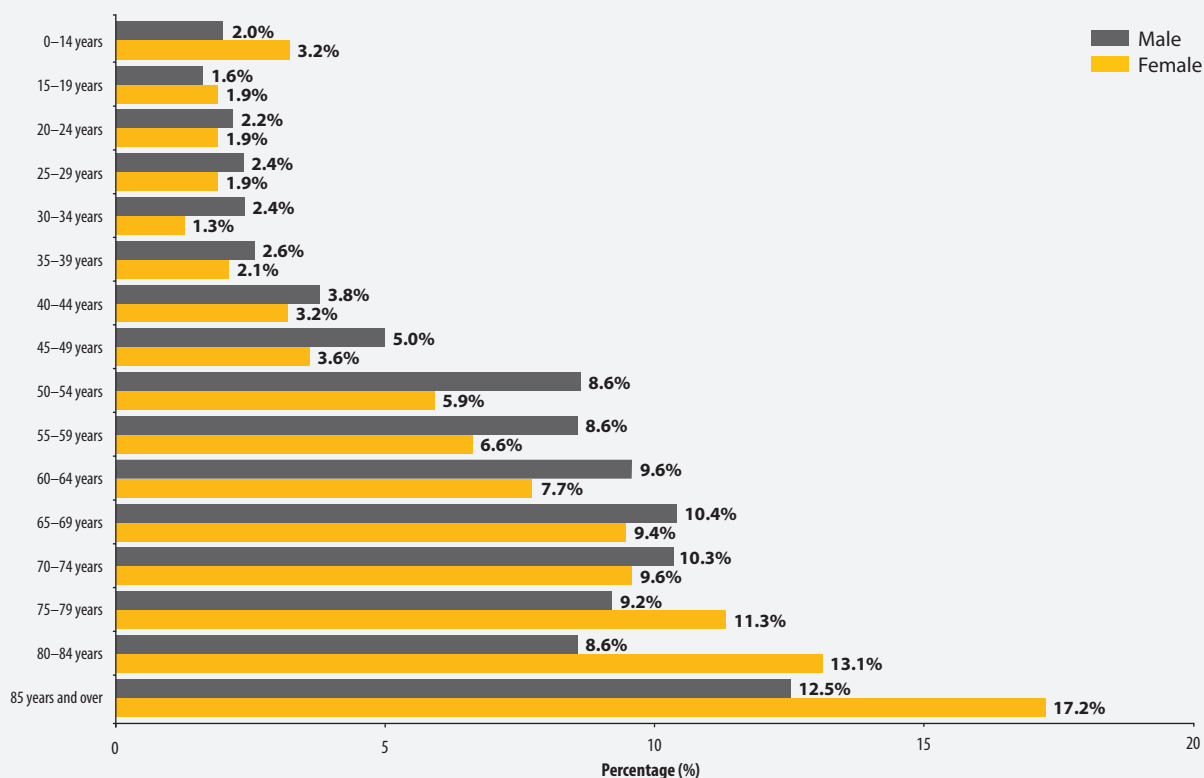


Figure 1: Age distribution of OHCA. (All events)

AGE DISTRIBUTION OF OHCA STANDARDISED

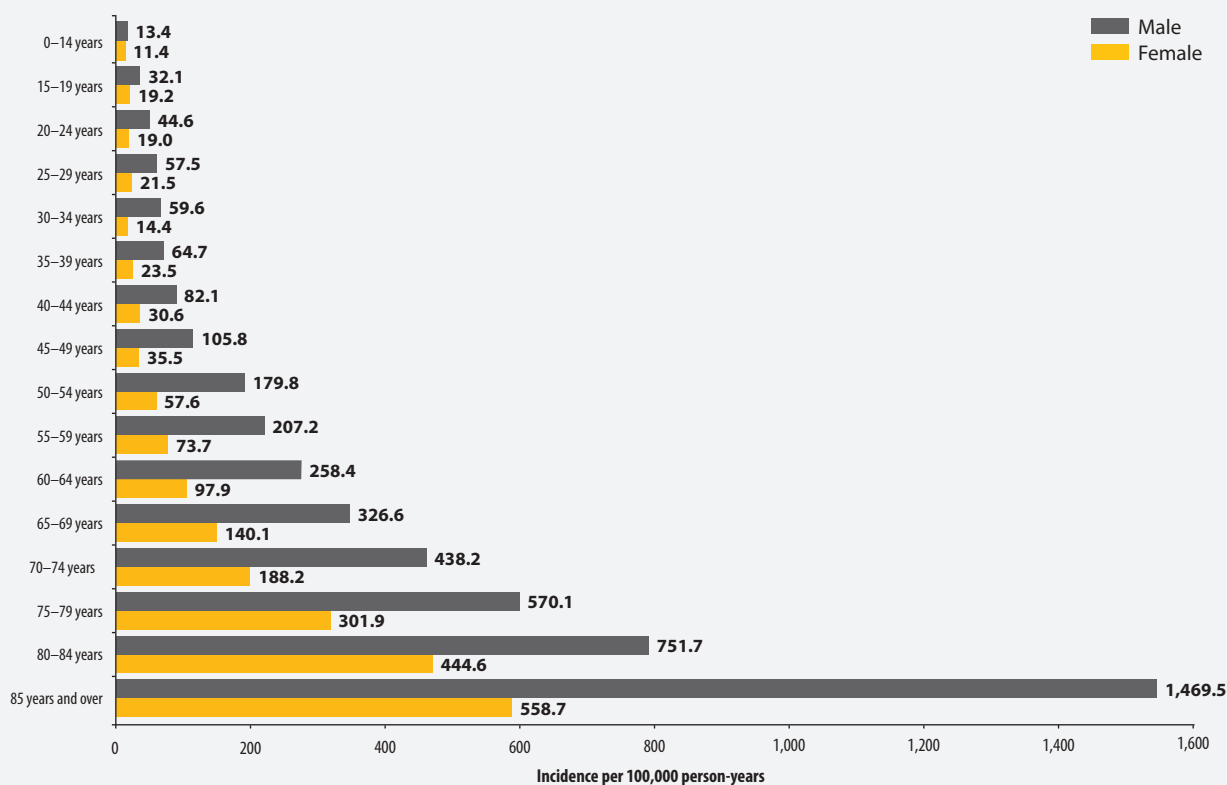


Figure 2: Age, standardised incidence of OHCA per 100,000 person-years. (All events)

Ethnicity

The majority of all OHCA events attended by St John EAS were for patients of European ethnicity, as defined by the Statistics New Zealand population groups¹⁴ (Figure 3).

When standardised to the New Zealand ethnic population groups, as a fraction of the parent population, Māori had a disproportionately higher incidence of OHCA per 100,000 person-years (122.4) compared with non-Māori (less than 90)¹⁴. This aligns with New Zealand Ministry of Health figures which indicate that Māori are disproportionately affected by ischaemic heart disease. Māori adults are 1.6 times more likely to be diagnosed with ischaemic heart disease than non-Māori adults²⁰. Conversely, people of Asian ethnicity had the lowest standardised incidence of OHCA (Figure 4).

Note: Within the ethnicity field the option exists for EAS crews to select “unknown” therefore ethnicity data is only fully established for 80% of entries. This is not surprising as following cardiac arrest the patient is often unconscious and it may not be possible to accurately determine ethnicity. Therefore this data should be viewed with caution.

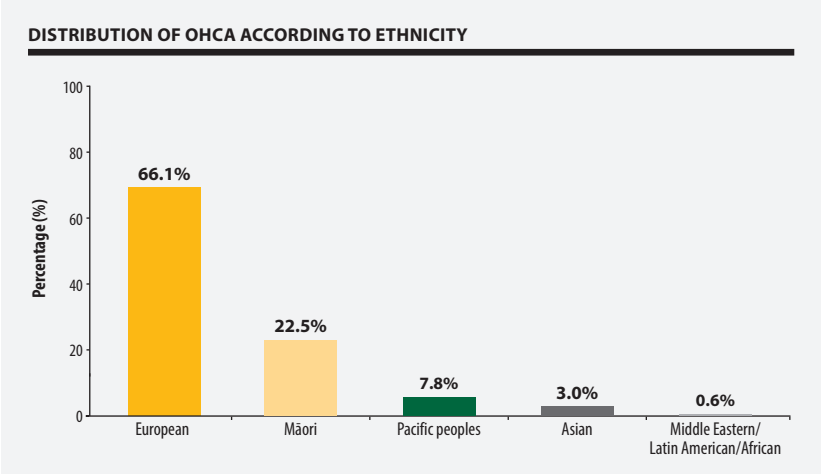


Figure 3: Distribution of OHCA according to ethnicity. (All events)

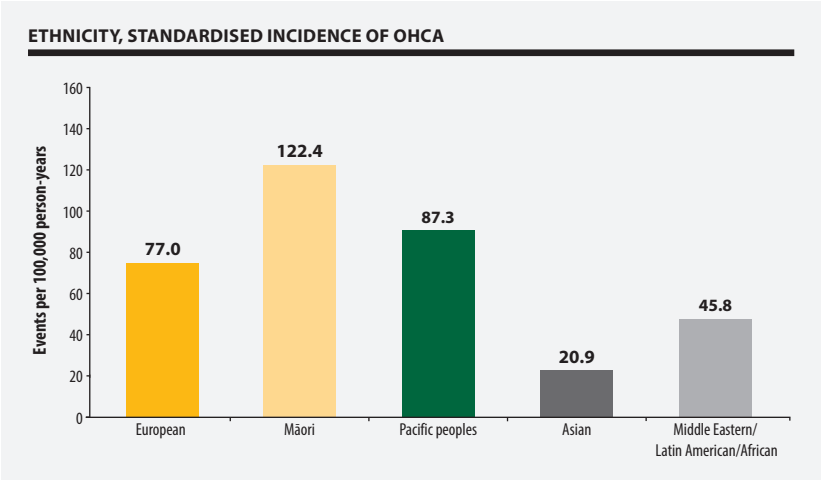


Figure 4: Ethnicity, standardised incidence of OHCA per 100,000 person-years. (All events)



Incidence across urban and rural/remote areas

The population within the St John jurisdiction is classified as urban or rural and remote as per Table 5. A larger proportion of the New Zealand population is based within metropolitan centres and consequently a greater portion of OHCA events attended by St John occurred within metropolitan localities (73%). There was no significant difference in the incidence rate between the urban population at 105.5 per 100,000 person-years and the rural/remote population at 109.0 per 100,000 person-years ($p=0.35$) (Figure 5).

The figures for the 2013/14 reporting period differ from those published previously due to a re-classification of the service areas. Based on the adjusted figures there was also no difference in the incidence rate between urban and rural/remote populations for the 2013/14 reporting period ($p=0.73$).

Incidence across regions of New Zealand

The response areas covered by St John are divided into three regions, Northern, Central and South Island Region. Northern Region covers the area from Hauraki to the Far North, Central Region covers from Horowhenua to the Waikato and South Island Region covers the entire South Island.

The incidence of OHCA per 100,000 person-years was calculated based on population estimates from Statistics New Zealand¹⁶. There was a significant difference in the incidence of OHCA between regions ($p<0.05$) (Figure 6). It is unknown why there is a difference in the incidence between regions.

Table 5: Definitions of urban, rural and remote service areas

Urban service area	Main urban centres with a population greater than 15,000. This includes responses that occur within a city boundary as per specified cluster of mesh blocks on the NZ Geographical Information Systems (GIS) service area map. For the purposes of this analysis this is inclusive of areas denoted by Statistics NZ as main urban area or satellite urban area^{15; 21; 22}.
Rural and remote service area	Rural and remote areas with a population of less than 15,000. This includes responses occurring in areas surrounding urban cities, minor urban/provincial centres and very rural and remote locations as per specified cluster of mesh blocks on the NZ GIS service area map. For the purposes of this analysis this is inclusive of areas denoted by Statistics NZ as any of the following: independent urban area, rural area with high urban influence, rural area with moderate urban influence, rural area with low urban influence or highly rural/remote area^{15; 21; 22}.

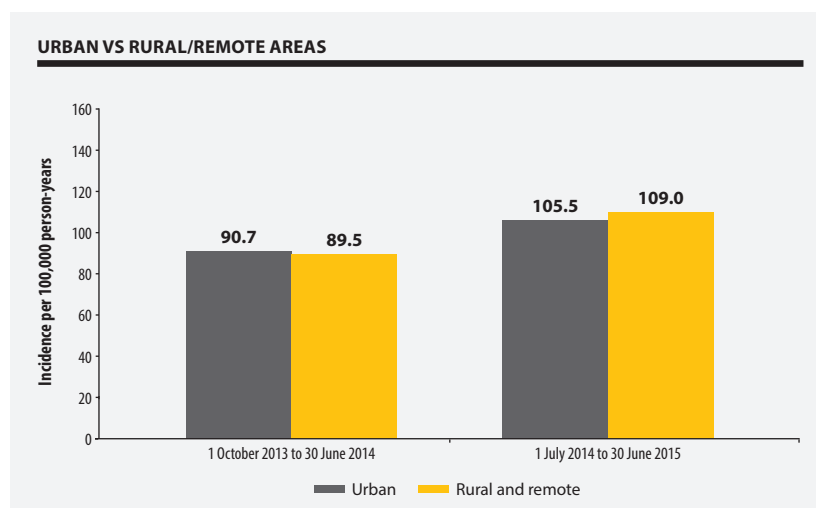


Figure 5: Urban versus rural/remote areas, incidence of OHCA per 100,000 person-years. (All events)

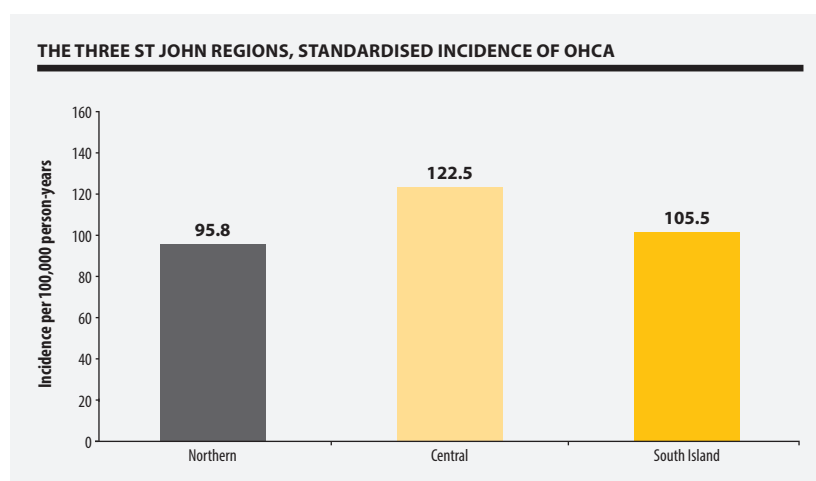


Figure 6: The three St John regions, incidence of OHCA per 100,000 person-years. (All events)



Heat map of OHCA events in the three St John regions

Red represents the highest concentration of OHCA on the heat map of OHCA events in the three St John Regions, followed by yellow and then green (Figure 7). The heat map in Figure 7 represents where the majority of events occur and is focused on areas of population density*.

Precipitating events for adults

St John EAS personnel presume an OHCA to be of cardiac cause unless it is known or likely to have been caused by trauma, drowning, poisoning or any other non-cardiac cause. The most common aetiology of OHCA in adults where resuscitation was attempted was that of a presumed cardiac cause, which constituted 77% of events.

Other common precipitating events included respiratory arrest (8%), trauma (4%) and hanging (3%). Note that the respiratory arrest category is inclusive of choking and asthma; and that anaphylaxis is included within the other non-cardiac category (Figure 8).

Precipitating events for children

The occurrence of OHCA in children is rare therefore cumulative data for a 21 month period from 1 October 2013 to 30 June 2015 was used for the analysis of precipitating events. During the 21 month period there were a total of 135 events in children where resuscitation was attempted. Of these, the leading cause of OHCA in children was SUDI at 33%, followed by respiratory arrest at 26% (Figure 9). Note that the respiratory

category is inclusive of choking and asthma and that anaphylaxis is included within other non-cardiac categories. These findings are consistent with those of the New Zealand Mortality Review Data Group, which show that the incidence of SUDI in New Zealand is one of the highest among industrialised countries and the leading cause of death in children aged less than one year¹⁹.

Arrest location

The most common place for an OHCA to occur is in a person's private residence, with 68% of events where resuscitation was attempted occurring at private residences. The second most common place for an OHCA to occur is in a public area (19%), which includes the workplace, the street, a shopping centre or similar (Figure 10). ■

* Heat map is not standardised to incidence per 100,000 person-years

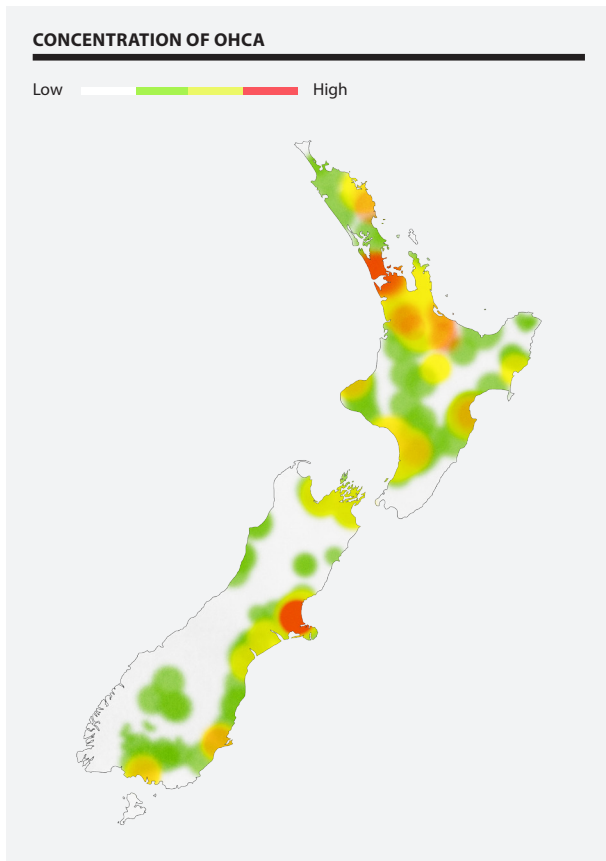


Figure 7: Concentration of OHCA events across the three St John regions.

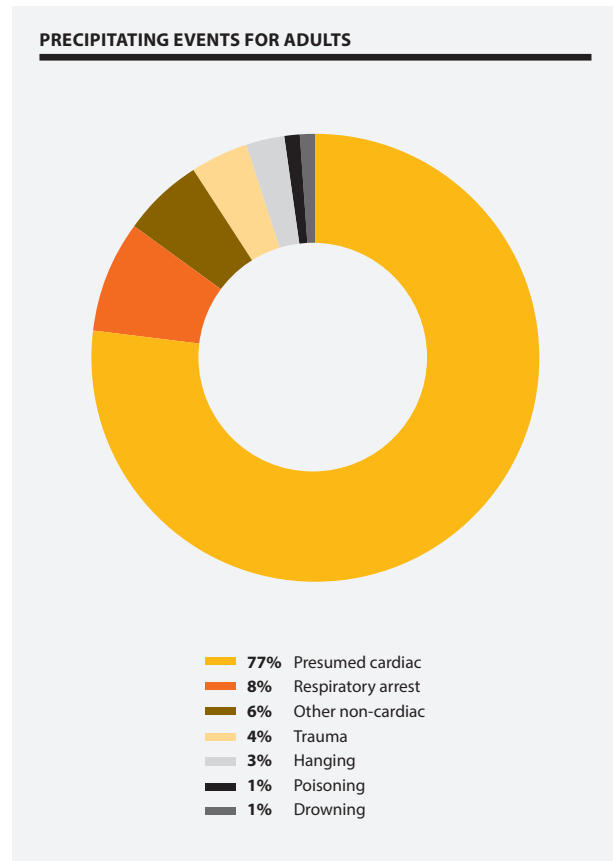


Figure 8: Precipitating events for adults. (Resuscitation attempted events)

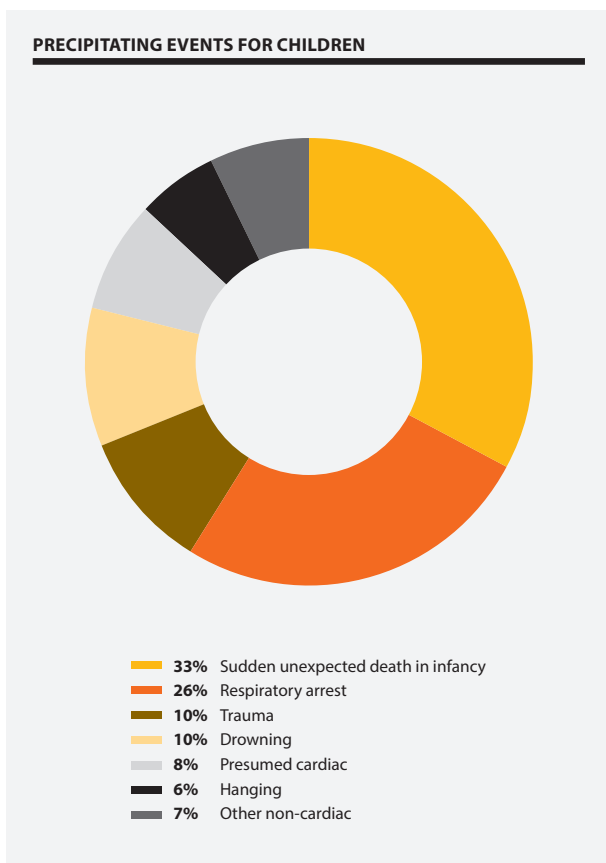


Figure 9: Precipitating events for children. (Resuscitation attempted events)

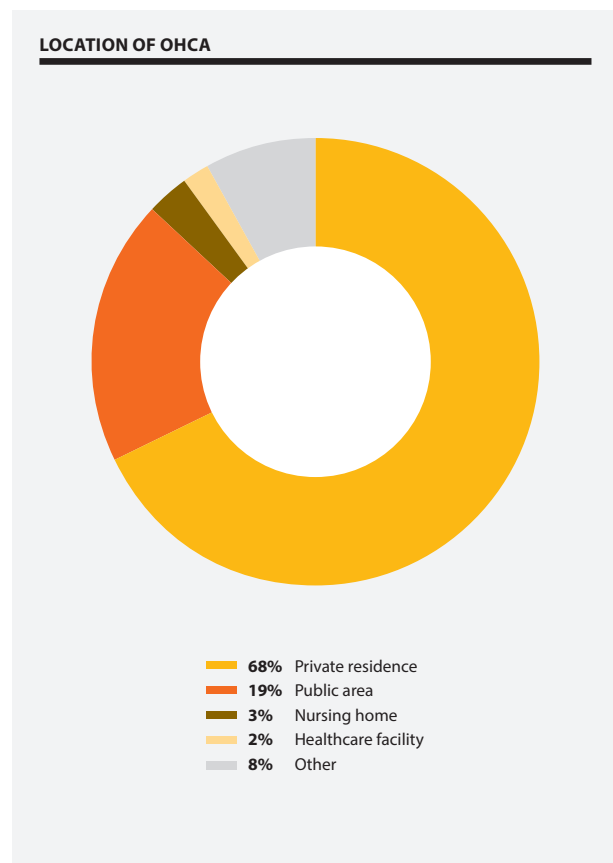


Figure 10: Location of OHCA. (Resuscitation attempted events)

The chain of survival

The gold standard in resuscitation optimises the key links in the chain of survival⁴:

- Immediate recognition of cardiac arrest and activation of the emergency response system
- Early CPR with an emphasis on chest compressions
- Rapid defibrillation
- Effective advanced life support. ■



1 Immediate recognition



2 Early CPR



3 Rapid defibrillation



4 Advanced life support

System response

King County EMS uses the phrase “It takes a system to save a victim”²³. The meaning of this statement is that it is the complex combination of all the elements and agencies in the pathway of a patient in cardiac arrest that leads to survival. This includes:

- the community response
- Clinical Control Centre personnel
- New Zealand Fire Service and other co-responders
- EAS, including first responders, emergency medical assistants,

emergency medical technicians, paramedics, intensive care paramedics, education personnel, clinical support personnel, quality improvement personnel and managers

- hospital personnel.

St John is continually working to improve the many elements within this complex pathway by focusing on factors that primarily affect the chain of survival: from immediate recognition, early CPR and rapid defibrillation, through to advanced life support.

**ST JOHN IS
WORKING TO
IMPROVE PATIENT
OUTCOMES
BY FOCUSING
ON FACTORS
THAT AFFECT
THE CHAIN OF
SURVIVAL**





Recognition and activation of the emergency response

The first step in the chain of survival is that bystanders in the community recognise a patient in cardiac arrest and phone 111 for an ambulance. Following on from this the next crucial time period is the time taken from when the call is answered in the Clinical Control

Centre to when an ambulance arrives. This is one of the key performance indicators for St John EAS and the target is to get trained personnel with a defibrillator to the patient in the shortest time possible.

For OHCA where resuscitation was attempted by St John EAS, the median response time (from

call pick up in the Clinical Control Centre to arrival of the ambulance on scene) for cardiac arrests was eight minutes in urban areas (n=1,489) and 11 minutes for rural and remote areas (n=579) (Figure 11 and Figure 12). These are similar response times to the international services against which St John is benchmarked⁸⁻¹² (Table 6).

Table 6: Benchmarking response times. (Resuscitation attempted events)

Ambulance service	Median response time (minutes)
St John	8 (urban)
	11 (rural and remote)
Wellington Free Ambulance ⁹	10 (urban)
	13 (rural and remote)
Ambulance Victoria ¹⁰	8 (urban)
	11 (rural and remote)
London Ambulance Service ⁸	6 (urban)
	N/A (rural and remote)
St John Ambulance Western Australia ¹¹	6 (urban)
	N/A (rural and remote)
King County EMS ¹²	5 (urban)
	10 (rural)

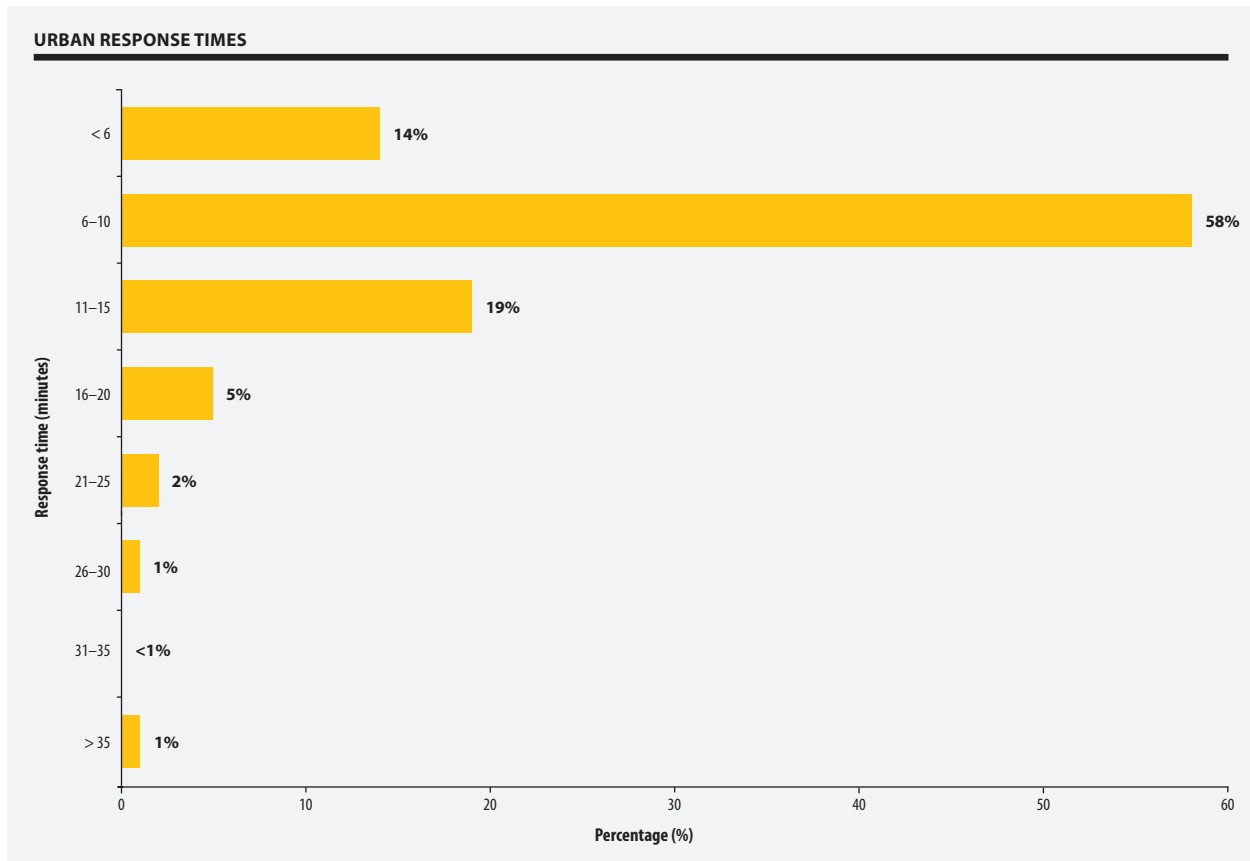


Figure 11: Urban response, time from call to arrival of ambulance. (Resuscitation attempted events)

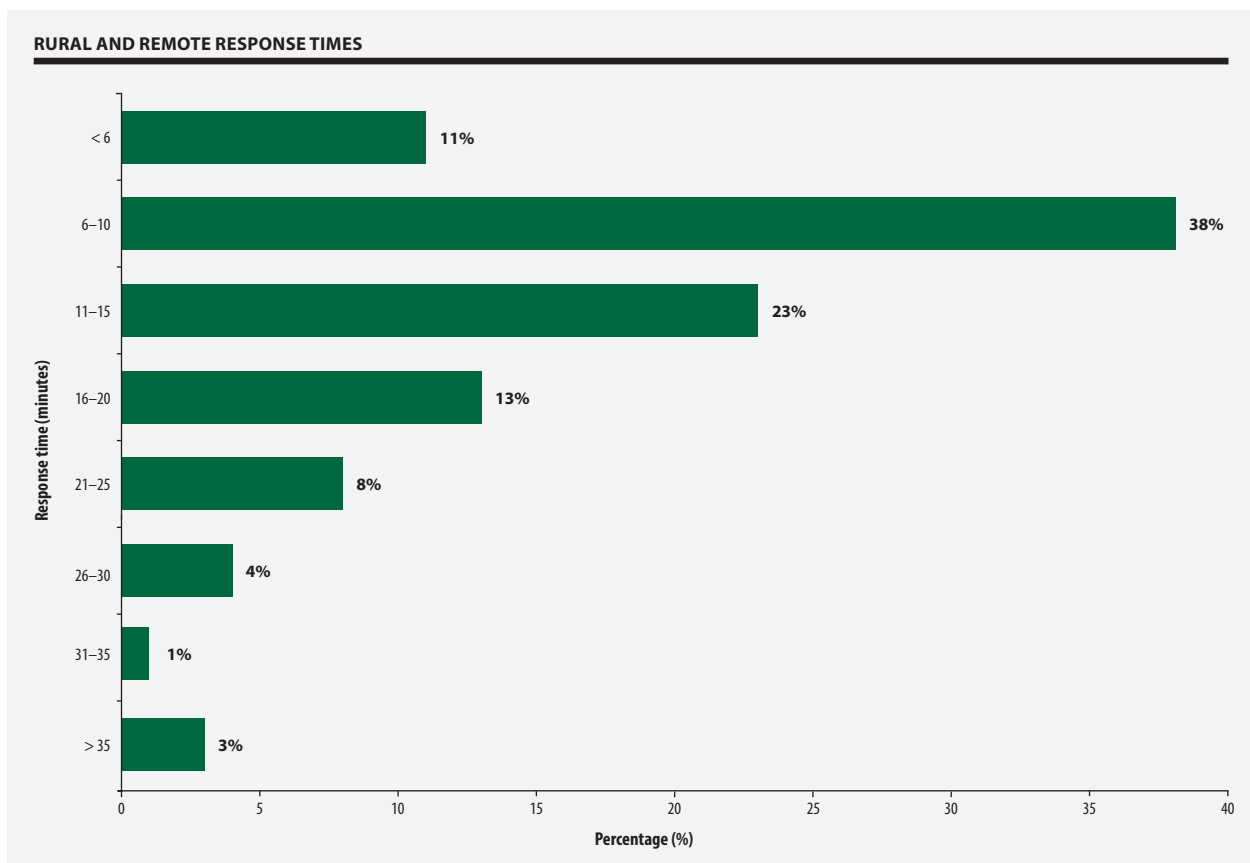


Figure 12: Rural and remote response, time from call to arrival of ambulance. (Resuscitation attempted events)

The community response

For every minute of cardiac arrest without CPR or defibrillation a patient's chance of survival falls by 10–15%²⁴. This makes the community and bystander response integral to survival from OHCA. If CPR is started before an ambulance arrives, the patient's chance of survival dramatically increases—any CPR is better than no CPR. Similarly the time until defibrillation for a patient in cardiac arrest can also have a significant impact on survival. Patients who are defibrillated within the first three to five minutes of cardiac arrest have the greatest chance of surviving²⁵.

To make improvements to the rate of bystander CPR and AED use, St John supports a number of community initiatives. The HEARTsafe community programme (www.heartsafe.org.nz) is a collaboration between St John, the New Zealand Fire Service and industry partner Laerdal. The goals of HEARTsafe are to increase healthy lifestyle awareness, increase the number of public AEDs, to train members of the public in AED use and to train members of the public in CPR. Currently we have 33 communities in New Zealand working towards HEARTsafe accreditation.

Businesses can also implement the HEARTsafe programme by teaching their employees to perform CPR, use an AED and installing AEDs in all of their locations.

In both this report and in the 2013/14 OHCA registry report it was identified that Māori are more at risk of cardiac arrest than non-Māori. The St John Pou Takawaenga (liaison officers) are working with maraes around New Zealand to engage with Māori and support them with access to AEDs and training in CPR and AED use.

St John has developed several online videos and a smartphone application which are freely



available to the public to help them learn CPR and AED use.

- **The St John CPR App**
(www.stjohn.org.nz/First-Aid/CPR-App/)
- **Learn how to do CPR**
(www.stjohn.org.nz/First-Aid/First-Aid-Library/Resuscitation/)
- **Learn how to use an AED**
(www.stjohn.org.nz/First-Aid/AED/)

A friends and family kit for learning CPR is also available from the St John Online Shop (<http://shop.stjohn.org.nz/>). This kit is designed to be shared and it is estimated that for every kit sold an additional two and a half people are trained.

St John recognises that children also have a role to play in a community response to an OHCA. Since January 2015 the St John in Schools programme has trained approximately 9,500 children in CPR and there are more than 6,000 St John Youth members engaged in learning first aid and CPR.

**FOR EVERY
MINUTE OF
CARDIAC ARREST
WITHOUT CPR OR
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BY 10–15%**

Rates of bystander CPR

In addition to the community response, Clinical Control Centre personnel play a pivotal role in the rates of early bystander CPR. As soon as St John emergency call handlers suspect a patient is in cardiac arrest they provide instructions to the caller over the phone on how to perform CPR.

Of the OHCA where resuscitation was attempted, 64% of these had bystander CPR performed prior to ambulance arrival (witnessed and unwitnessed combined). This figure has remained consistent with last year's result (65%) (Figure 13). This is also comparable to rates of bystander CPR reported internationally: Ambulance Victoria 75% (bystander witnessed), London Ambulance 56% (witnessed and unwitnessed combined) and King County EMS 69%^{8, 10, 23}.

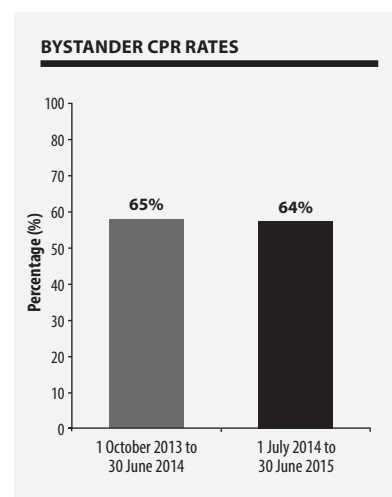


Figure 13: Percentage of OHCA with bystander CPR. (Resuscitation attempted events)

Time to defibrillation

Nearly 20% of cardiac arrests occur in a public area, therefore public access defibrillators and community first aid training have a large role to play in early defibrillation. If a St John emergency call handler suspects they are dealing with a cardiac arrest, one of the first questions they ask is if an AED is available. If so, they provide instructions on how to use it, as well as on how to perform CPR.

When a public access defibrillator is used the chance of the patient surviving is substantially increased with 69% of patients surviving to hospital discharge if an AED was used prior to EAS arrival. In comparison 24% of patients survived to hospital discharge if a defibrillator was used after EAS arrival. However, the total number of patients defibrillated using public access defibrillators was extremely low constituting only 4% of events that occurred in public.

St John has implemented a number of systems to ensure that patients in cardiac arrest are reached in the shortest time possible by responders trained in CPR and with access to a defibrillator. A cardiac arrest is allocated the highest priority response by Clinical Control Centre personnel and the closest resource is immediately dispatched. This may be an emergency ambulance or any trained responder including the St John Patient Transfer Service, the New Zealand Fire Service, first response groups or PRIME doctors and nurses. By dispatching the closest resource, defibrillation and CPR can occur in the quickest possible time, which may be sooner than EAS arrival.

The New Zealand Fire Service

Since December 2013 the New Zealand Fire Service has been part of the team of professionals available to co-respond to an

OHCA. During this reporting period (1 July 2014 to 30 June 2015), the Fire Service attended more than 73% (n=1,523) of all OHCA events where a resuscitation attempt was made by EAS.

Early CPR is one of the key links in the chain of survival and in 18% of OHCA events where resuscitation was attempted by EAS the New Zealand Fire Service arrived on scene first to provide early CPR and use an AED prior to ambulance arrival.

The New Zealand Fire Service has been fundamental in the early defibrillation of 95 patients in cardiac arrest prior to the arrival of St John EAS. Of these patients, 35% survived the event (ROSC sustained to hospital handover) and 19% survived to hospital discharge. ■



Outcomes

Scene outcome for OHCA in adults

One of the contributing factors in patient survival is good quality of chest compressions during CPR. Performing CPR during the transport of a patient following an OHCA may compromise the quality of the CPR being delivered²⁶. Therefore, in the majority of OHCA events, it is appropriate to continue resuscitation at the scene of the arrest until either ROSC occurs or resuscitation is ceased. This is reflected in the scene outcomes observed in adult patients where resuscitation was

attempted by St John EAS (Figure 14). The overall percentage of patients transported with CPR in place was 4%, transported with ROSC was 32% and died at the scene was 64%.

Adult outcome from all-cause cardiac arrest

Survival from OHCA is the foremost factor in benchmarking the performance of EAS internationally. The results from the St John OHCA registry show an event survival rate (ROSC sustained to hospital handover) of 31% (Figure 15). This is similar to the 2013/14 reporting

period at 30% and this result is benchmarked with other services in Figure 16.

The rate of survival to hospital discharge in adults where resuscitation was attempted was 15%. This rate remains the same as the rate that was reported for the nine months prior (Figure 15). The rate of survival to discharge is benchmarked with other services in Figure 17.



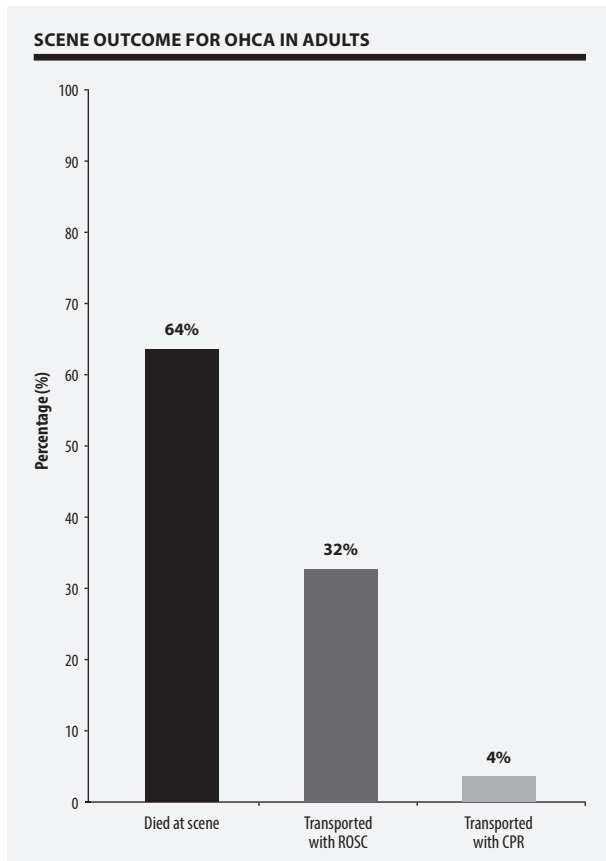


Figure 14: Scene outcome for OHCA in adults. (Resuscitation attempted events)

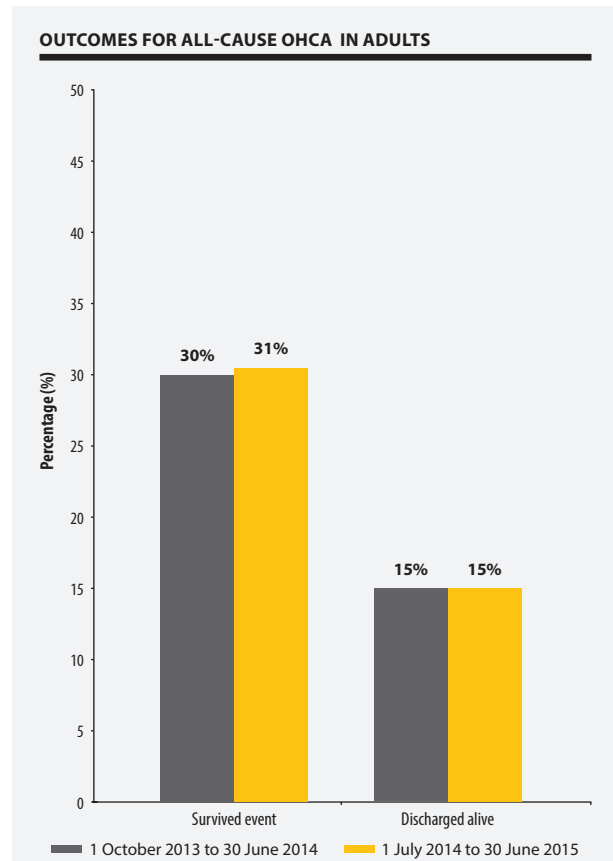


Figure 15: Outcomes for all-cause OHCA in adults. (Resuscitation attempted events)

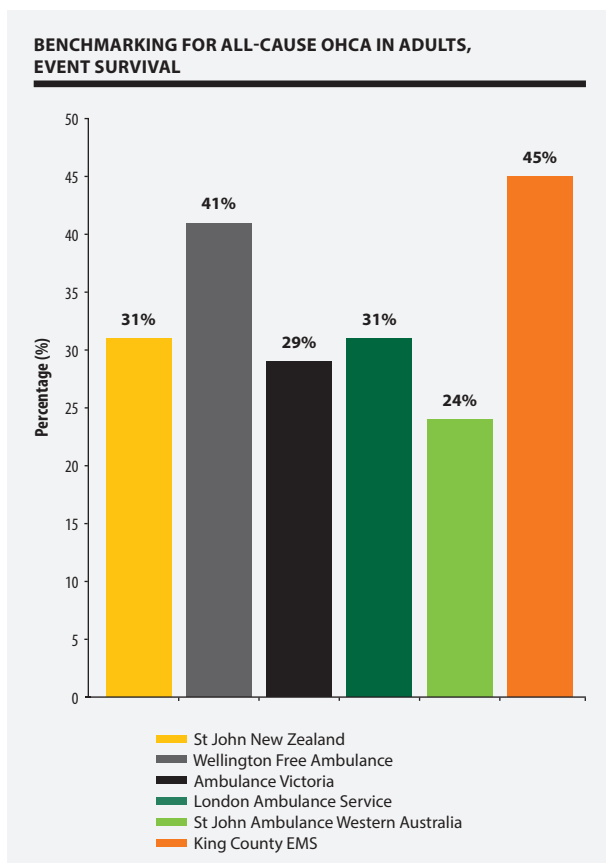


Figure 16: Benchmarking for all-cause OHCA in adults, survived event rates. (Resuscitation attempted events)

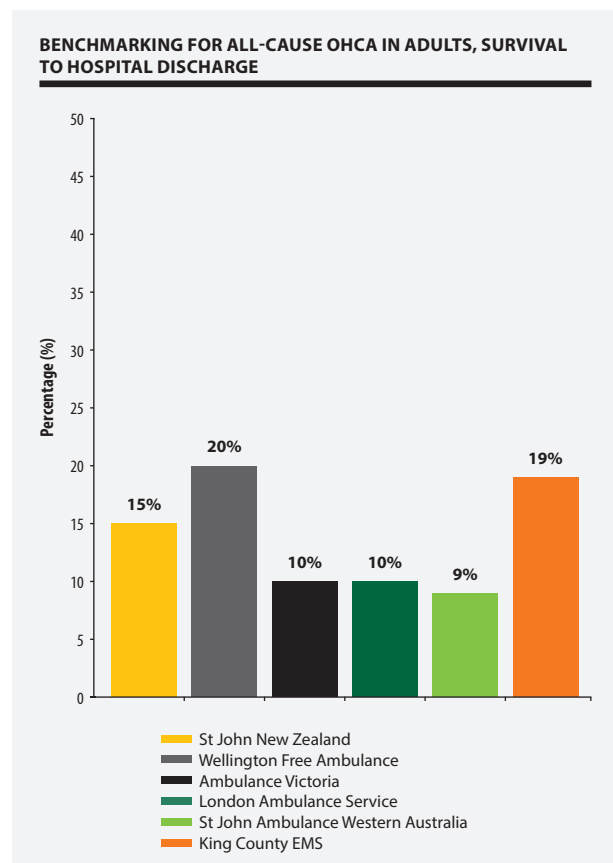


Figure 17: Benchmarking for all-cause OHCA in adults, survival to hospital discharge. (Resuscitation attempted events)

Adult outcomes according to presenting rhythm

Patients that present with a shockable rhythm such as ventricular fibrillation (VF) or ventricular tachycardia (VT), have a markedly greater chance of survival than patients who present with a non-shockable rhythm such as pulseless electrical activity (PEA) or asystole.

Due to the small number of patients for some of the categories of presenting rhythms, outcomes according to presenting rhythm were analysed on cumulative data for a 21 month period (n=3,311, 1 October 2013 to 30 June 2015).

Adult patients who had resuscitation attempted by St John EAS personnel and presented with a shockable rhythm had an event survival rate of 49%. This compares with 29% for those in PEA and 12% for those in asystole. Similarly, adult patients presenting with a shockable rhythm had a greater chance of being discharged alive from hospital at 33%. This compares with 7% for those in PEA and 2% for those in asystole (Figure 18).

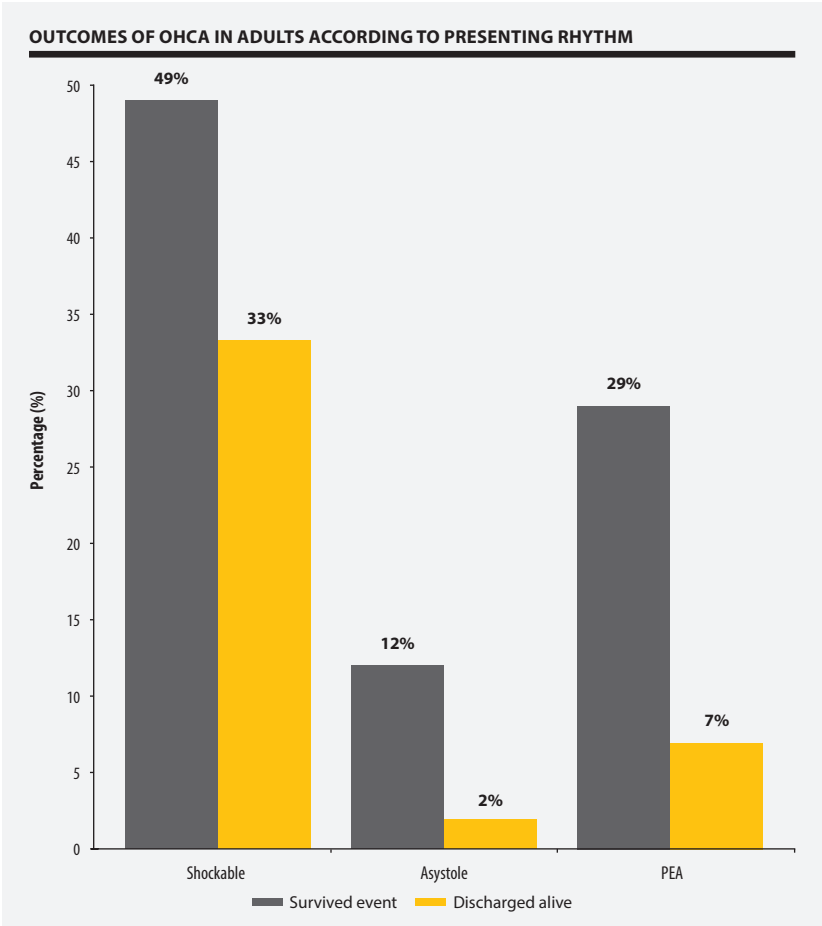


Figure 18: Outcomes for OHCA in adults according to presenting rhythm. (Resuscitation attempted events)



If a patient presents with a shockable rhythm and the arrest is witnessed by ambulance officers, the immediate intervention of defibrillation can lead to the greatest survival outcomes. For the 21 month period analysed, of the adult patients who had a shockable presenting rhythm where the arrest was witnessed by St John ambulance officers (n=199), the rate of event survival was 74% and survival to hospital discharge was 59%.

Adult outcomes by selected subgroup

A specifically selected subgroup of patients, who are considered to be the most likely to survive, is sometimes used to benchmark against other ambulance services. This subgroup is referred to as the “Utstein comparator group” by the London Ambulance Service and requires the following criteria to be met: that a resuscitation is attempted by the EAS, the arrest is

bystander witnessed, the patient has a shockable presenting rhythm and the incident is of presumed cardiac aetiology⁸. The number of cardiac arrests attended by St John that met these criteria was 569 which constituted 27% of all events where resuscitation was attempted by St John (Figure 19).

For this selected subgroup survival to hospital discharge rate was 36% and this result is benchmarked against other services in Figure 20.

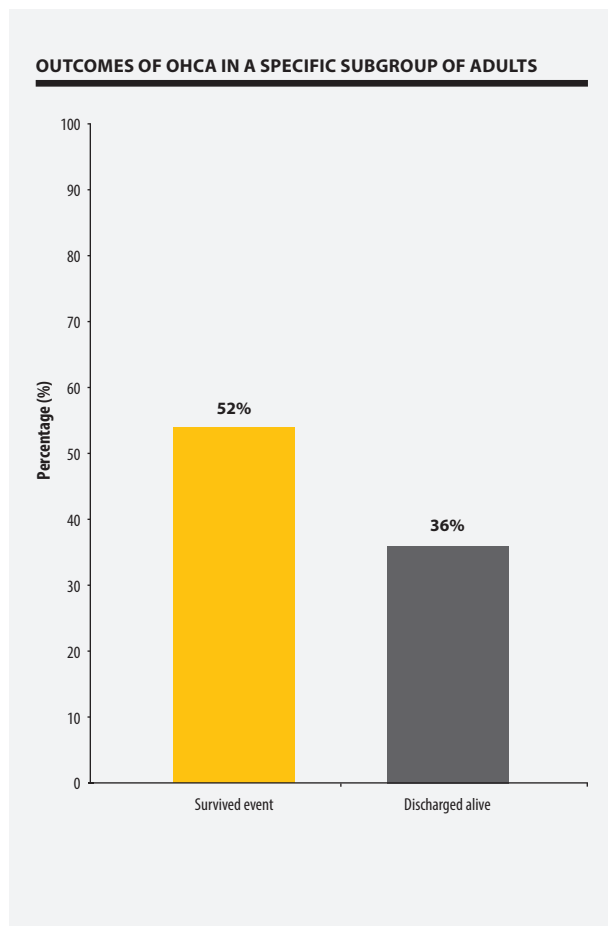


Figure 19: Outcomes for OHCA in adults where the arrest is bystander witnessed, has a shockable presenting rhythm and is of presumed cardiac aetiology. (Resuscitation attempted events)

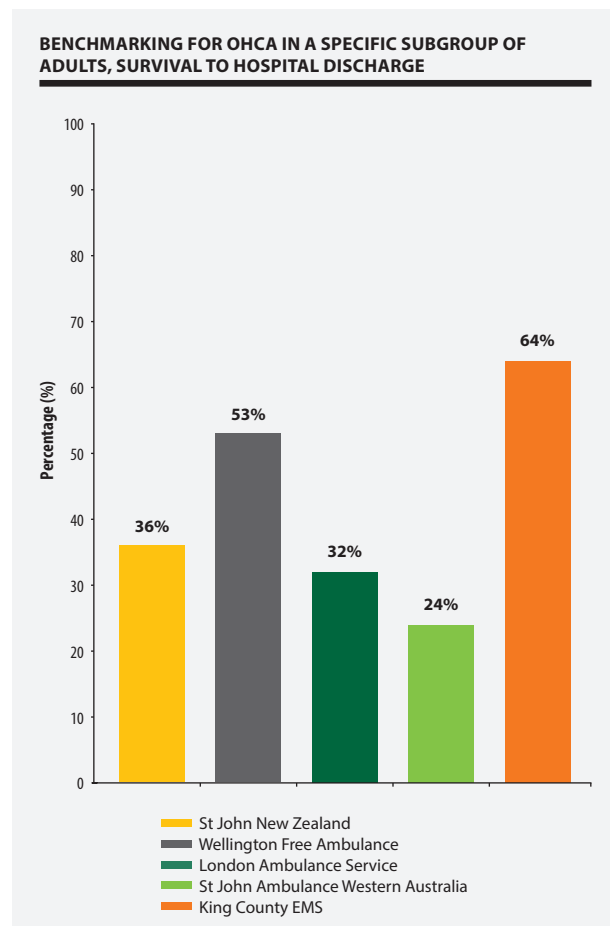


Figure 20: Benchmarking hospital discharge rates in adults where the arrest is bystander witnessed, has a shockable presenting rhythm and is of presumed cardiac aetiology. (Resuscitation attempted events)*

* Data not available for Ambulance Victoria

Adult outcomes according to rurality

Patients that had a cardiac arrest in a rural or remote location had a significantly lower percentage of event survival ($p=0.0062$) but no significant difference in survival to hospital discharge ($p=0.32$) when compared to patients that had a cardiac arrest in an urban location (Figure 21).

Adult outcomes according to region

As only a small number of cardiac arrests occur annually in each region, outcomes for event survival and survival to discharge at a regional level are measured across a 21 month period from 1 October 2013 to 30 June 2015. Event survival was not significantly different between any of the St John regions ($p>0.05$), with Northern Region at 33%, Central Region at 28% and South Island Region at 31% (Figure 22).

Northern and South Island Regions had similar survival to hospital discharge rates at 18% and 17% respectively. However, Central Region had a significantly lower rate of survival to discharge at 13% than both Northern ($p=0.004$) and

South Island ($p=0.014$) Regions (Figure 22).

It is unknown why there is a difference in the survival to hospital discharge between regions. Response times were investigated and there was no significant difference between the median or mean response times between any of the regions ($p>0.05$).

Adult outcomes according to location

The low number of OHCA where resuscitation was attempted at healthcare facilities ($n=39$) and nursing homes ($n=56$) creates a large variance in the survival rates. Therefore comparisons of survival in relation to location can only be accurately made between the two predominant locations, private residence and in a public area.

Cardiac arrests where resuscitation was attempted by EAS were more likely to have been witnessed when the OHCA occurred in a public area (80%) as opposed to those that occurred at a private residence (63%). Events where resuscitation was attempted were also more likely to have bystander CPR performed when the OHCA occurred in a public area (78%) as opposed to those that occurred at a private residence (61%).

Survival from OHCA is substantially influenced by whether a cardiac arrest is witnessed and bystander CPR is performed⁴. This is reflected in the higher rates of survival to hospital discharge observed in the group of patients that suffered a cardiac arrest in a public area (25%) compared to those who were at a private residence at the time (10%) (Figure 23).

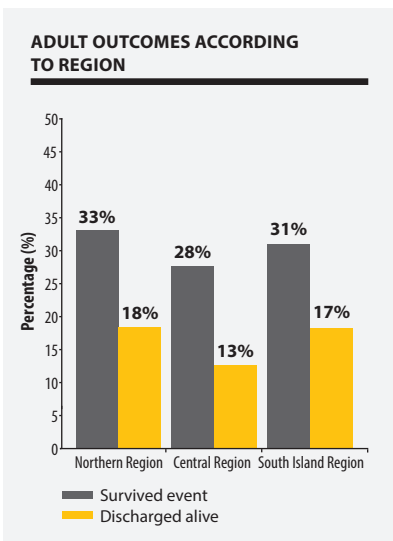


Figure 22: The three St John regions, influence of region on outcome. (Resuscitation attempted events)

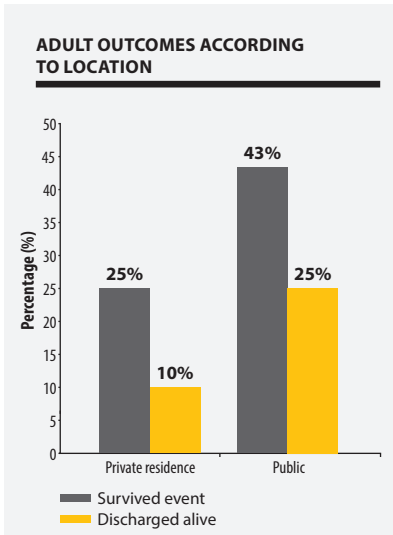


Figure 23: Private residence and public, influence of location on outcome. (Resuscitation attempted events)

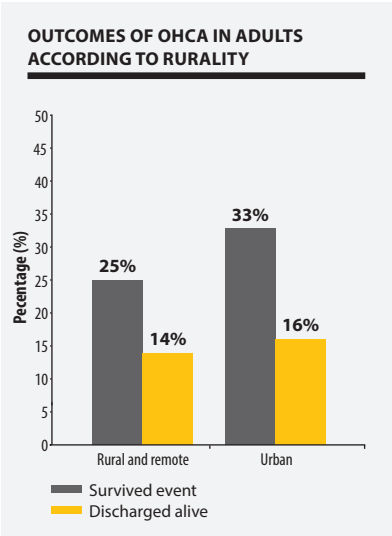


Figure 21: Rural/remote versus urban areas, influence of location on outcome. (Resuscitation attempted events)

Outcomes from all-cause OHCA occurring in children

OHCA occurring in children is rare with a total of only 106 events attended by St John EAS for this reporting period. Due to the low incidence of cardiac arrest within the 12 month period, outcomes were instead analysed on cumulative data for a 21 month period (n=188, 1 October 2013 to 30 June 2015).

The precipitating causes for OHCA in children and the factors affecting survival differ markedly from adults. In children the presenting rhythm is seldom shockable. Only 5% (n=7) of children who had resuscitation attempted by St John EAS personnel (n=135) presented with a shockable rhythm. The most common precipitating event for

OHCA in children is SUDI (n=45) for which there were no survivors. Overall the rate of event survival for children where resuscitation was attempted by St John EAS was 16% (n=22) and survival to hospital discharge was 9% (n=12). However, due to the low total number of events in children these rates must be interpreted with caution because there is insufficient data to have confidence in the results.

continual improvement within St John. As a result, new processes, technologies and research strategies may be implemented and the impact of these strategies can be measured. Measuring changes in outcomes year-on-year enables St John to improve the treatment of OHCA, ultimately leading to higher patient survival rates. ■

Conclusion

The data presented in this report indicates that the service provided by St John in treating OHCA continues to be of a high quality and compares favourably with other emergency ambulance services internationally. The data in this report will drive discussion on clinical improvements as part of ongoing service planning and



Abbreviations

AED	Automated external defibrillator	MPDS	Medical priority dispatch system
CAD	Computer aided dispatch	OHCA	Out-of-hospital cardiac arrest
CPR	Cardiopulmonary resuscitation	PEA	Pulseless electrical activity
DHB	District Health Board	PRIME	Primary response in medical emergencies
EAS	Emergency ambulance service	ROSC	Return of spontaneous circulation
ECG	Electrocardiogram	SUDI	Sudden unexpected death in infancy
EMS	Emergency Medical Services	VF	Ventricular fibrillation
EMT	Emergency medical technician	VT	Ventricular tachycardia
ICP	Intensive care paramedic		

Definitions

Adult	Patients aged 16 years of age or older.
Children	Patients aged less than 16 years of age.
EAS attended	This is the population of all patients following cardiac arrest where St John EAS was in attendance regardless of whether emergency treatment is provided.
EAS personnel	Where St John ambulance personnel respond to a medical emergency in an official capacity as part of an organised medical response team.
Presumed cardiac aetiology	An OHCA is presumed to be of cardiac aetiology, unless it is known or likely to have been caused by trauma, drowning, poisoning or any other non-cardiac cause.
Return of spontaneous circulation	The patient shows clear signs of life in the absence of chest compressions for more than 30 seconds. Signs of life include any of the following: normal breathing, palpable pulse, normal end tidal CO ₂ or normal movement.
Resuscitation attempted	The performance of CPR by or under the direction of responding staff, or the delivery of a shock at any time (including before ambulance arrival).
Shockable rhythm	Ventricular fibrillation, ventricular tachycardia or unknown shockable (AED).
Survived event	The patient has sustained ROSC to handover at hospital.
Survival to discharge	The patient has been discharged from hospital alive.
Witnessed event	A witnessed cardiac arrest is one that is seen or heard by another person.

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District Health Board

Hawke's Bay
District Health Board

Hutt Valley
District Health Board

Lakes
District Health Board

MidCentral
District Health Board

Nelson Marlborough
District Health Board

Northland
District Health Board

South Canterbury
District Health Board

Southern
District Health Board

Tairāwhiti
District Health Board

Taranaki
District Health Board

Waikato
District Health Board

Wairarapa
District Health Board

Waitemata
District Health Board

West Coast
District Health Board

Whanganui
District Health Board

References

- 1 **Smith, T., Bailey, M., Drewry, A., Ellis, C., Mann, S., Swain, A., & Civil, I.** (2013). Clinical Procedures and Guidelines Comprehensive Edition 2013 - 2015. (Report No. CDT507): St John.
- 2 **Ministry of Health.** (2013). Mortality and Demographic Data 2010. Wellington: Ministry of Health.
- 3 **Berdowski, J., Berg, R. A., Tijssen, J. G., & Koster, R. W.** (2010). Global incidences of out-of-hospital cardiac arrest and survival rates: systematic review of 67 prospective studies. *Resuscitation*, 81(11), 1479-1487.
- 4 **Travers, A. H., Rea, T. D., Bobrow, B. J., Edelson, D. P., Berg, R. A., Sayre, M. R., Berg, M. D., Chameides, L., O'Connor, R. E., & Swor, R. A.** (2010). Part 4: CPR overview 2010 American Heart Association guidelines for cardiopulmonary resuscitation and emergency cardiovascular care. *Circulation*, 122(18 suppl 3), S676-S684.
- 5 **Finn, J., Bernard, S., Jacobs, I., Cameron, P., Smith, K., Tonkin, A., & Thompson, P.** (2012). Australian Resuscitation Outcomes Consortium (Aus-ROC). *Resuscitation*, 83, e59-e60.
- 6 **Jacobs, I., Nadkarni, V., Bahr, J., Berg, R., Billi, J., Bossaert, L., Cassan, P., Coovadia, A., D'Este, K., & Finn, J.** (2004). Cardiac arrest and cardiopulmonary resuscitation outcome reports: update and simplification of the Utstein templates for resuscitation registries. *Resuscitation*, 63(3), 233-249.
- 7 **Chamberlain, D., Cummins, R. O., Abramson, N., Allen, M., Baskett, P., Becker, L., Bossaert, L., Deloof, H., Dick, W., & Eisenberg, M.** (1991). Recommended guidelines for uniform reporting of data from out-of-hospital cardiac arrest: the 'Utstein style'. *Resuscitation*, 22(1), 1-26.
- 8 **Virdi, G., Nicholas, P., & Fothergill, R.** (2014). London Ambulance Service NHS Trust. Cardiac Arrest Annual Report: 2013/14. London UK: NHS. Retrieved from http://www.londonambulance.nhs.uk/about_us/publications.aspx
- 9 **Swain, A., Wang, K., & Cameron, H.** Wellington Free Ambulance: OHCA statistics 1 July 2014 to 30 June 2015. Personal Communication. Email 05/10/2015
- 10 **Smith, K., & Lijovic, M.** (2014). Victorian Ambulance Cardiac Arrest Registry: Annual Report 2013 - 2014. Victoria, Australia: Department of Research & Evaluation Ambulance Victoria.
- 11 **Inoue, M., Bailey, P., Smith, A., & Finn, J.** St John Ambulance Western Australia: OHCA statistics 1 July 2013 to 30 June 2014. Personal Communication. Email 16/09/2015
- 12 **Stubbs, B.** King County Emergency Medical Services: OHCA statistics 1 January 2013 to 31 December 2013. Personal Communication. Email 16/09/2015
- 13 **Statistics NZ.** (2014). Estimated Resident Population by Age and Sex (1991+) (Annual-Jun). Retrieved June 2015, from <http://www.stats.govt.nz/infoshare/SelectVariables.aspx?pxID=974edf4f-ff5d-46ce-928f-6c3f46a6cd77>
- 14 **Statistics NZ.** (2014). Dataset: Estimated resident population (ERP), subnational population by ethnic group, age, and sex, at 30 June 1996, 2001, 2006, and 2013. Retrieved May 2015, from <http://nzdotstat.stats.govt.nz/WBOS/Index.aspx?DataSetCode=TABLECODE7512>
- 15 **Statistics NZ. Estimated Resident Population.** New Zealand: Urban/rural profile areas. At 30 June 2001-13. Retrieved June 2015, from <http://www.stats.govt.nz/~media/Statistics/browse-categories/maps-and-geography/geographic-areas/urban-rural-profile-update/population-estimates.xls>
- 16 **Statistics NZ.** (2013). Table: Estimated Resident Population for Territorial Authority Areas, at 30 June(1996+) (Annual-Jun). Retrieved June 2015, from <http://www.stats.govt.nz/infoshare/SelectVariables.aspx?pxID=8fec48b0-27e7-44b4-bca2-acb450388cab>
- 17 **Office for National Statistics.** Statistical bulletin: 2012-based Subnational Population Projections for England. Retrieved 20/08/2014, from <http://www.ons.gov.uk/ons/rel/snpp/sub-national-population-projections/2012-based-projections/stb-2012-based-snpp.html#tab-Projections-for-Regions>
- 18 **OECD.** (2011). Infant mortality rates (indicator). Retrieved 4 August, 2014, from <http://data.oecd.org/healthstat/infant-mortality-rates.htm#indicator-chart>

- 19 **NZ Child and Youth Mortality Review Committee.** (2014). 10th Data Report 2009 – 2013: The NZ Mortality Review Data Group, University of Otago. Retrieved from <http://www.hqsc.govt.nz/our-programmes/mrc/cymrc/publications-and-resources/publication/1311/>
- 20 **Ministry of Health.** (2014). Annual Update of Key Results 2013/14: New Zealand Health Survey. Retrieved from <http://www.health.govt.nz/system/files/documents/publications/annual-update-key-results-nzhs-2013-14-dec14.pdf>
- 21 **Statistics NZ.** (2013). Urban/Rural Profile (experimental) Classification Categories. Retrieved July 2014, from <http://www.stats.govt.nz/methods/classifications-and-standards/urban-rural-profile-experimental-class-categories.aspx>
- 22 **Statistics NZ.** 2013 Census meshblock dataset. Retrieved September 2015, from <http://www.stats.govt.nz/Census/2013-census/data-tables/meshblock-dataset.aspx>
- 23 **Chatalas, H., & Plorde, M.** (2014). Public Health - Seattle & King County Division of Emergency Medical Services 2014 Annual Report to the King County Council. Seattle USA: Public Health Seattle & King County. Retrieved from <http://www.kingcounty.gov/healthservices/health/ems.aspx>
- 24 **Valenzuela, T. D., Roe, D. J., Cretin, S., Spaite, D. W., & Larsen, M. P.** (1997). Estimating effectiveness of cardiac arrest interventions a logistic regression survival model. *Circulation*, 96(10), 3308-3313.
- 25 **Berg, R. A., Hemphill, R., Abella, B. S., Aufderheide, T. P., Cave, D. M., Hazinski, M. F., Lerner, E. B., Rea, T. D., Sayre, M. R., & Swor, R. A.** (2010). Part 5: Adult basic life support 2010 American Heart Association guidelines for cardiopulmonary resuscitation and emergency cardiovascular care. *Circulation*, 122(18 suppl 3), S685-S705.
- 26 **Olasveengen, T. M., Wik, L., & Steen, P. A.** (2008). Quality of cardiopulmonary resuscitation before and during transport in out-of-hospital cardiac arrest. *Resuscitation*, 76(2), 185-190.



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