Out-of-Hospital Cardiac Arrest Register

OHCAR Ireland

At the heart of evidence

Annual Report 2020

Feidhmeannacht na Seirbhíse Sláinte
Health Service Executive

Pre-Hospital Emergency Care Council

NUI Galway
OÉ Gaillimh

Contents

OUT OF HOSPITAL CARDIAC ARREST REGISTER KEY FINDINGS 2020

DEMOGRAPHICS

2,638
out-of-hospital arrest incidents were recorded as attended by the EMS

67%

33%

82% **PRIVATE SETTING***
*Includes 'home', 'farm' or 'residential institution'

75% **OCCURRED IN THE HOME**

18% **PUBLIC**

EMERGENCY MEDICAL SERVICES

83% cardiac arrest recognition by emergency call takers

64% epinephrine administered

53% advanced airway use

33% transported to hospital

21% defibrillation performed

15% EMS witnessed cases survived

COMMUNITY INVOLVEMENT

84%

60%

Since 2012, Bystander CPR has increased from 60% to 84%

6%
defibrillated before EMS arrival (n=161)

47/161
people survived

*CFR groups were temporarily stood down in March 2020

POST CARDIAC ARREST OUTCOME

164 PEOPLE
Returned home to their communities

98%
98% of survivors were recorded as having a good neurological outcome

28%
28% of patients in the Utstein comparator group survived to hospital discharge

EMS – Emergency Medical Services CPR – Cardio Pulmonary Resuscitation CFR – Community First Responder

OHCAR Key Messages 2020

Overall Patient and Event Characteristics

- 2,638 out-of-hospital cardiac arrest incidents recorded on OHCAR (55 per 100,000 population in 2020)
  - 56% occurred in an urban area [a]
  - 67% Male
  - Median age 68 years (interquartile range 52 – 79)
  - 84% presumed medical cause
  - 75% happened in the home
  - 84% Bystander CPR attempted
  - 50% Bystander witnessed
  - 6.1% of patients had defibrillation attempted pre EMS arrival
  - 16% had sustained ROSC to Hospital arrival

Survivors - Patient and Event Characteristics

164 patients survived

- 6.2% Discharged alive
  - 137 had good to moderate neurological function on discharge

Utstein Group

- 12% of patients were in the Utstein Group [b] [10]
  - 51% ROSC pre-hospital
  - 42% ROSC on arrival at hospital
  - 28% were discharged alive

[a]Definition of urban is matched with the CSO definition of a settlement i.e. defined as having a minimum of 50 occupied dwellings, with a maximum distance between any dwelling and the building closest to it of 100 metres, and where there is evidence of an urban centre [15].

[b]The Utstein subgroup includes patients who are >17 years, with presumed medical aetiology, bystander witnessed event and an initial shockable rhythm.

Abbreviations

B-CPR	Bystander Cardiopulmonary Resuscitation
BLS	Basic Life Supporter
CFR	Community First Responder
CPC	Cerebral Performance Category
CPR	Cardiopulmonary Resuscitation
CRI	Call Response Interval
CSO	Central Statistics Office
DAA	Dublin Airport Authority
DFB	Dublin Fire Brigade
ED	Emergency Department
EMS	Emergency Medical Services
ePCR	Electronic Patient Care Record
ERC	European Resuscitation Council
EuReCa	European Registry of Cardiac Arrest
GP	General Practitioner
HRB	Health Research Board
HSE	Health Service Executive
IQR	Interquartile Range
NAS	National Ambulance Service
OHCAR	Out-of-Hospital Cardiac Arrest Register
PCR	Patient Care Records
PEA	Pulseless Electrical Activity
PHECC	Pre-Hospital Emergency Care Council
pVT	Pulseless Ventricular Tachycardia
ROSC	Return of Spontaneous Circulation

Chapter 1

1.0 Introduction – OHCAR and COVID-19

The Coronavirus (COVID-19) first emerged during December 2019, and reached Ireland by February 2020. By May 2021, this contagious virus had been confirmed in over 225 million people, and has been linked to over 4.6 million deaths globally (WHO, 2021) [1]. On the 27th of March 2020 the National Ambulance Service (NAS) temporarily stood down the Community First Responder (CFR) groups in the interests of maintaining the CFR's health and safety.

As 2020 progressed HSE advice on dealing with a suspected COVID positive patient included the mandatory use of personal protective equipment (gloves, facemask, gown and eye protection). Due to the risk of spreading the virus during aerosol generating procedures, which includes cardiopulmonary resuscitation, the International Liaison Committee on Resuscitation (ILCOR) [2] advised against these procedures. People stayed at home more during the year due to lockdown and various appeals to them to do so. This had the potential to influence the locations of out-of-hospital cardiac arrest incidents with fewer of them occurring in public locations. These events would therefore be witnessed by fewer bystanders. These factors could negatively affect cardiac arrest outcomes. OHCAR contributed data to HSE guidance regarding CPR and Do-not-attempt resuscitation decision making during the COVID pandemic [3].

1.1 The National Out-of-Hospital Cardiac Arrest Register (OHCAR)

The OHCAR project was established in June 2007 in response to a recommendation in the "*Report of the Task Force on Sudden Cardiac Death*" [4]. The need for OHCAR was also emphasised in the policy document "*Changing Cardiovascular Health*" [5] and the "*Emergency Medicine Programme Strategy*" [6]. Since 2020, OHCAR is one of six OHCA registries in Europe with full national coverage.

1.2 The OHCAR Steering Group and Governance

OHCAR is hosted by the Department of Public Health Medicine in the Health Service Executive (HSE) North West region, and is funded by the National Ambulance Service (NAS). It is administered and supported by the Discipline of General Practice, National University of Ireland Galway, and is guided by the OHCAR Steering Group (Appendix 1).

1.3 The Aim of OHCAR

The aim of OHCAR is to support improved outcomes from OHCA in Ireland by:

- Collecting information on the population who suffer OHCA and the arrest circumstances
- Collecting information on the pre-hospital treatment of OHCA patients
- Monitoring the survival to hospital discharge of OHCA patients
- Establishing a sufficiently large patient database to enable identification of the best treatment methods for OHCA and optimum organisation of services
- Providing regular feedback to service providers
- Facilitating research on best practice nationally and internationally using OHCAR data

1.4 OHCAR reporting to Service Providers

OHCAR is used to provide data for the 'ROSC at Hospital' monthly clinical Key Performance Indicator for NAS, and also to provide detailed regional quarterly reports. These include descriptive data elements and outcome variables at regional level and constitute the data source for reports circulated by NAS to stations for the ONELIFE initiative, which is a NAS run quality improvement programme. A quarterly report is provided to Dublin Fire Brigade (DFB) with outcome data and descriptive information. OHCAR Annual reporting is undertaken on the geographical regions of West, South and combines the DFB with the Eastern NAS region.

1.5 Ireland and the EuReCa Studies

EuReCa TWO was launched in September 2016. OHCAR has provided National OHCA data for incidents in Ireland to the EuReCa TWO study, which covered 28 European countries with a population of almost 179 million people. Ireland was one of only four countries that contributed data for the entire country for the study period. Data collection commenced on the 1st of October 2017 until the 31st of December 2017. The EuReCa TWO study was published in 2020 [7]. In October 2014, Ireland participated in the EuReCa ONE [8,9] study – a one-month survey of OHCA cases in 27 countries across Europe. Ireland was one of only seven countries that contributed data for the entire country for the study period.

Chapter 2

2.0 Methods

2.1 Inclusion / Exclusion Criteria

OHCAR registers "all patients who suffer a witnessed or un-witnessed out-of-hospital cardiac arrest in Ireland which is confirmed and attended by Emergency Medical Services (EMS) and resuscitation attempted". A resuscitation attempt is defined as performance of cardiopulmonary resuscitation (CPR) and/or attempted defibrillation where there is evidence of a cardiac arrest rhythm.

2.2 Source of OHCAR Data

The primary sources of OHCAR data are Patient Care Records (PCRs) and dispatch data from the two statutory ambulance services, the National Ambulance Service (NAS) and the Dublin Fire Brigade (DFB). OHCAR has data sharing agreements with other organisations including the Dublin Airport Authority (DAA), Red Cross, Civil Defence, Irish Coastguard and Order of Malta, but almost all data is provided from statutory services. At present, the work undertaken by Community First Responder (CFR) groups is not fully captured in OHCAR data.

2.3 Data Collection

OHCAR collects data in the format of the internationally agreed Utstein dataset [10,11].

National Ambulance Service: NAS introduced electronic PCRs (ePCR), and during 2020 OHCAR identified 98% (n=2,167/2,218) of cases via the ePCR system. A small proportion of PCRs are also collected from ambulance stations on a monthly basis, digitised and stored on a central database. PCRs for OHCA incidents are identified by NAS staff and fast-tracked for digitising. Following validation, OHCAR staff uploads the data onto the OHCAR database. OHCAR receives NAS dispatch data monthly from the National Emergency Operations Centre (NEOC) in Tallaght and this data is added to each record in the OHCAR database.

Dublin Fire Brigade: PCRs are sourced by DFB's EMS Support Unit and data are provided to OHCAR on a quarterly basis in a summarised electronic format. These records are integrated with data from the DFB East Region Command Centre in Townsend Street. Electronic copies of DFB PCRs are also sent to OHCAR to enable case validation.

Hospitals: OHCAR has a data sharing agreement with all hospitals who receive OHCA patients except Our Lady's Children's Hospital, Crumlin. Data collection from hospitals is facilitated by various hospital staff, including administrators, resuscitation officers, clinical nurse managers and consultants. Acute hospitals provide information on survival status and Cerebral Performance Category (CPC) score [c] [12,13].

2.4 Aetiology

As per the Utstein definition, where there is no evidence of another cause, e.g. trauma, asphyxiation, drug overdose cases were presumed to be of medical aetiology.

2.5 Data Quality Management

The Utstein guidelines state that, "organisers of OHCA registries should implement monitoring and remediation for completeness of case capture" [11]. The quality of data variables for each OHCAR case is vital to the usefulness of the register. Responsibility for accurate and comprehensive data recording lies with the emergency practitioners who attend the OHCA scene. OHCAR works with NAS and DFB to enhance data quality by providing quarterly reports which include a summary of the availability of some core data elements. NAS then produces and circulates OHCAR summary reports to ambulance stations on a quarterly basis. DFB also provide each practitioner access to their quarterly reports.

The following data quality checks are also undertaken:

- Case duplication searches
- Checking for inconsistent and/or conflicting data values
- Validation of initial data entries and against OHCAR inclusion criteria
- Clinical expertise is provided by the OHCAR Steering Group when required

2.6 Statistical Analysis

Data analysis was performed using IBM SPSS version 27. In all cases $p<0.05$ was used as the level of statistical significance. Where appropriate, relationships between categorical values were expressed in percentages and examined by the Chi square test for significance [14].

[c]Cerebral Performance Category (CPC) score is an assessment score developed to assess both traumatic and anoxic cerebral injuries.

Chapter 3

3.0 Results for 2020

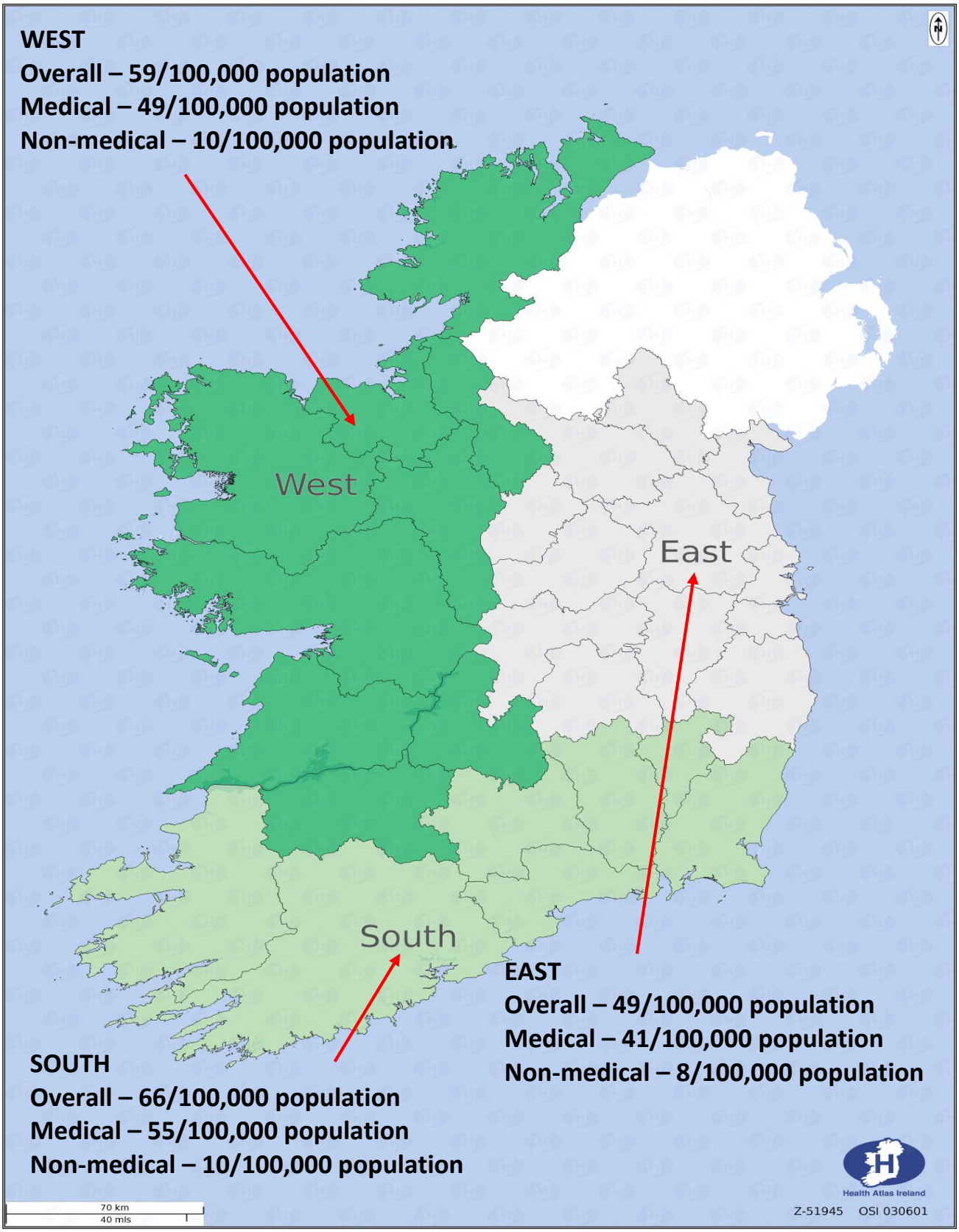
3.1 Incidence

In 2020, a total of **2,638** OHCA were attended where resuscitation was reported to have been attempted by NAS, DFB, DAA or bystanders (9% were not treated by the EMS due to the recognition of death on arrival at scene (n=240/2,638)). Of these, 17% were reported directly to OHCAR, 82% were identified during examination of NAS ePCRs and <1% were identified during missing case searches. This equates to 55 OHCA resuscitation attempts per 100,000 in 2020 [15] (49/100,000 East, 66/100,000 and 59/100,000 in the West, ($p<0.001$)). In Europe, the estimated incidence of OHCA ranges between 27 and 91 per 100,000 per year [16].

In 2020, the majority of OHCA incidents were presumed to be of medical aetiology (46/100,000 persons) compared to a small proportion of cases of non-medical aetiology (trauma, asphyxial, drug overdose or submersion) (9/100,000 persons). The HSE South Area reported the highest incidence at 66/100,000 persons (Map 1) [d].

[d]Population data from Census of Population 2016 [15].

Map1: Incidence of OHCA with resuscitation attempts in 2020



3.2 Geographical Distribution of Incidents

The geographical coordinates of incident locations were mapped using the HSE application 'Health Atlas' (https://www.healthatlasireland.ie/). Map 2 highlights that the majority of cases occurred in the most populated areas. The classification of an urban area matches with the Central Statistics Office (CSO) definition of a settlement i.e. defined as having a minimum of 50 occupied dwellings, with a maximum distance between any dwelling and the building closest to it of 100 metres, and where there is evidence of an urban centre [15].

- 56% of cases occurred in an urban area (n=1,401/2,481); 157 cases could not be geocoded due to insufficient data or the event having occurred during ambulance transport (106 and 51 respectively)
- Case incidence was 42/100,000 in 2020 in urban areas and 75/100,000 population in rural areas.

Map 2: Geographical distribution of OHCAR Incidents with settlement/non-settlement classification

3.3 Demographics

- 1,760 patients were male (67%)
- Patients ranged in age from less than one to 104 years old (median age 68 years, interquartile range (IQR) 52 – 79)
- Females were older than males (71 years (IQR 55 – 82) vs. 66 years (IQR 51 – 77) respectively), ($p<0.001$)
- Females were more likely to collapse in a private setting (homes or residential institutions) than males (n=791/875, 90% v 1,368/1,760, 78%), ($p<0.001$).

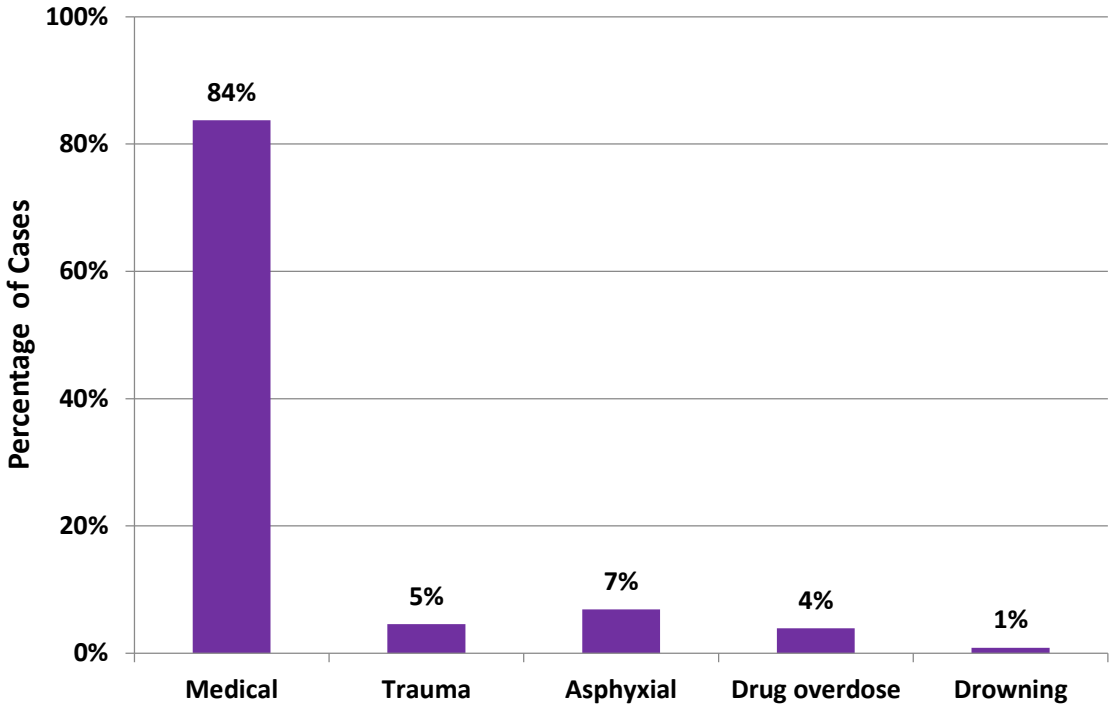
3.4 Community First Responders

In January 2020 there were 266 Community First Responder (CFR) groups linked with NAS and there was approximately 1,800 AEDs identified to National Emergency Operations Centre (NEOC). The CFR group members are predominantly made up of lay people with an interest in providing life-saving support in their communities, and receive training prior to activation from the NAS National Emergency Operations Centre. The CFR groups operate on a voluntary basis and are trained in basic life support and the use of defibrillators. They are co-ordinated locally by volunteers, work under the auspices of the National Ambulance Service policy, and are dispatched by ambulance control. The CFR groups were deactivated in March and were gradually returned to practice in December 2020.

3.5 Presumed Aetiology

- 84% of incidents were presumed to be of medical aetiology (n=2,209/2,638)
- Non-medical aetiologies included (Figure 1):
    - 7% asphyxia (n=182)
    - 4% trauma (n=121)
    - 4% drug overdose (n=103)
    - 1% submersion (n=23)
- 82% of male patients had a presumed medical aetiology (n=1,450/1,760) compared to 87% of female patients (n=758/875), ($p<0.003$).
- Patients with a presumed medical aetiology were significantly older than all other aetiologies (70 years vs. 44 median years respectively).

Figure 1: Presumed aetiology (n=2,638)



3.6 Call Response Interval

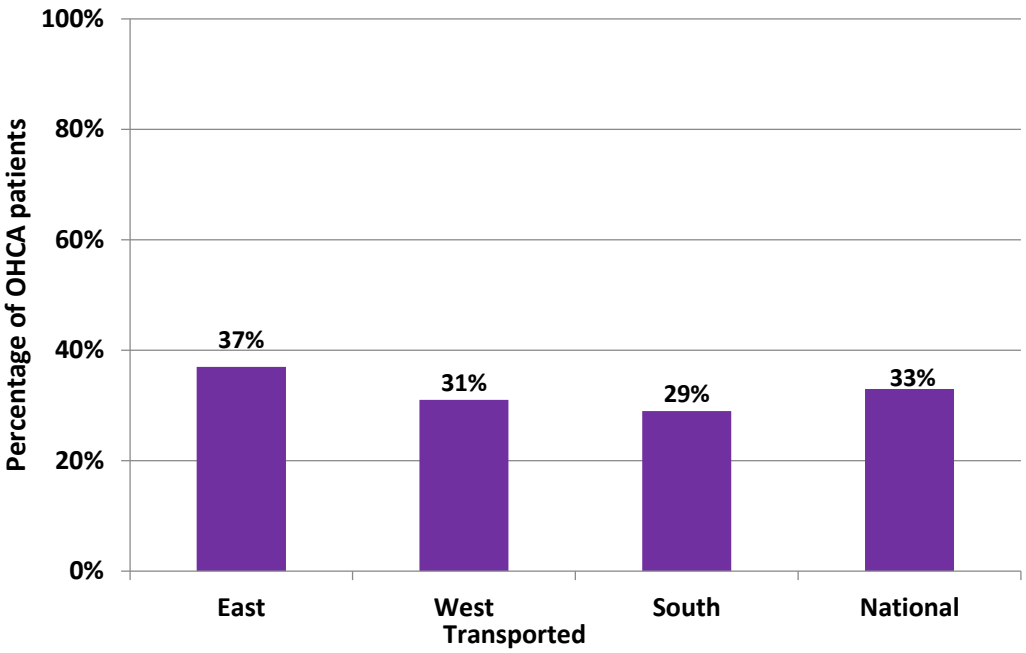
As per the Utstein definition [10], the call response interval (CRI) is the interval from the time the emergency call was received at the dispatch centre to arrival of EMS at the scene. Only the CRI for non-EMS witnessed cases are included in this analysis (n=2,320/2,638). As CRI is not normally distributed, the median value for each category is given:

• All non EMS witnessed cases	14 minutes (IQR 9 – 20 minutes)
• Rural non EMS witnessed cases	18 minutes (IQR 13 – 25 minutes)
• Urban non EMS witnessed cases	10 minutes (IQR 7 – 15 minutes)
• Utstein comparator group	12 minutes (IQR 8 – 18 minutes)

3.7 Transported to Hospital

- 33% of patients were transported to either an Emergency Department or a cardiac catheterisation laboratory (n=868/2,638)
- The percentage of patients who were transported to hospital was 37% in the East, 31% in the West, and 29% in the South, (p<0.001), (Figure 2)
- Patients in urban areas were more likely to be transported than in rural areas (37% vs. 23%, p<0.001).

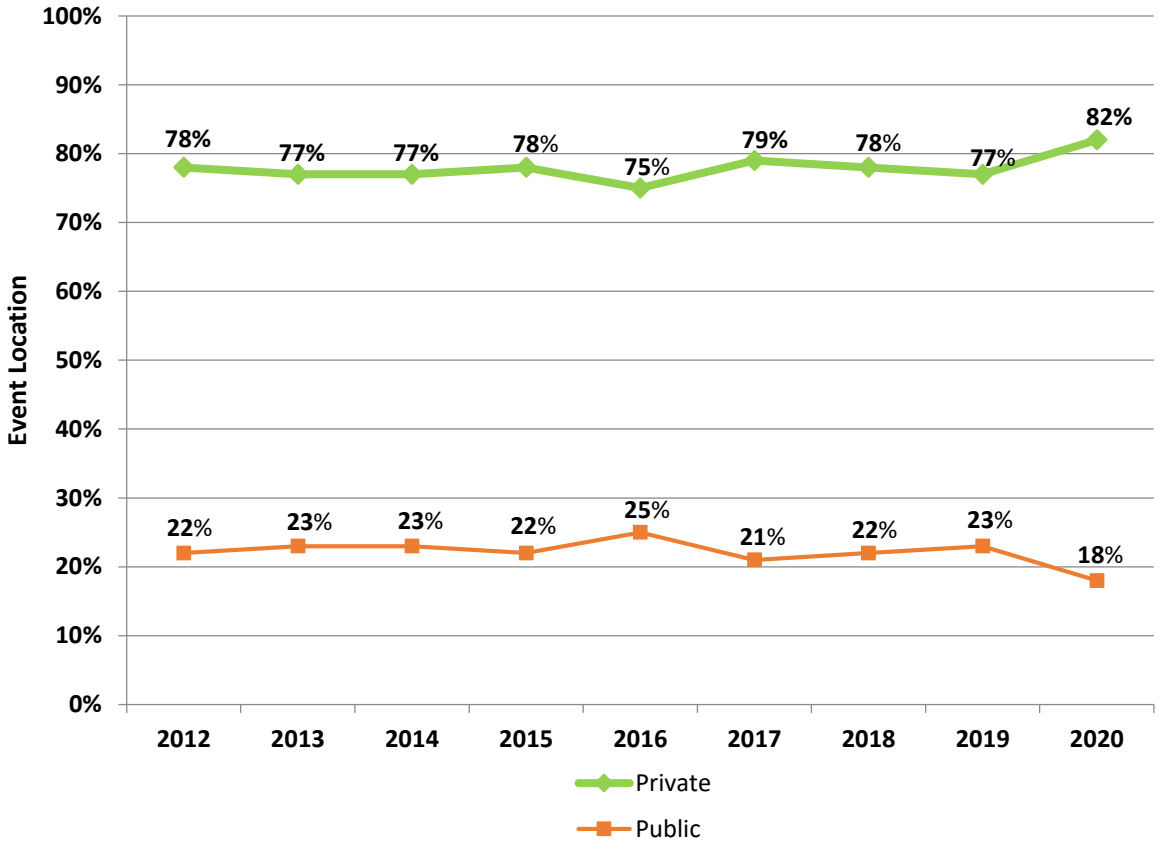
Figure 2: Proportion of patients transported to hospital by EMS area and nationally



3.8 Event Location

- 75% of incidents occurred in the home (n=1,974/2,638)
- 82% of incidents occurred in a private setting (home, farm or residential institution (n=2,161/2,638) (Figure 3)
- 18% of cases occurred in a public setting (industrial place, public building, GP surgery, recreational or sports place, street or road, in the ambulance, and other places such as rivers, lakes or piers (n=477/2,638) (Figure 3)
- In urban areas, a higher proportion of patients collapsed in a public place compared to rural areas (14% vs. 18%), (p<0.134).

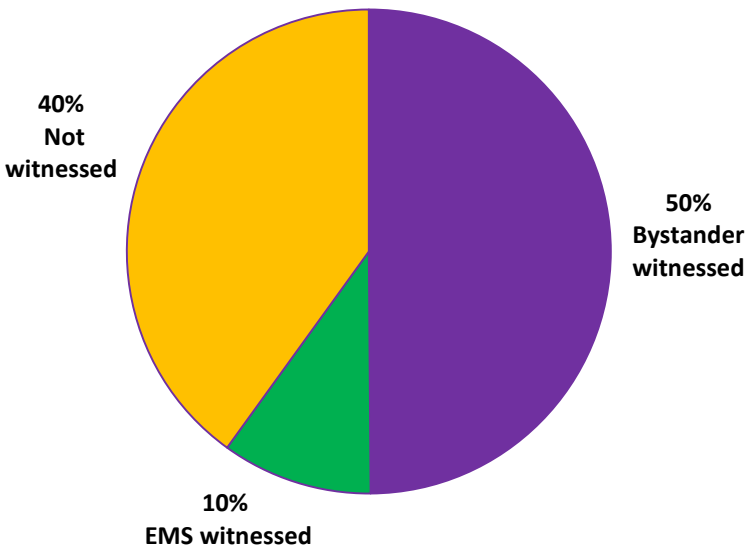
Figure 3: Event Location



3.9 Witness Status

- 50% of cases were bystander witnessed (n=1,287/2,580), (Figure 4)
- 50% of urban cases were bystander witnessed (n=683/1,358) and 51% of rural cases were bystander witnessed (n=550/1067).

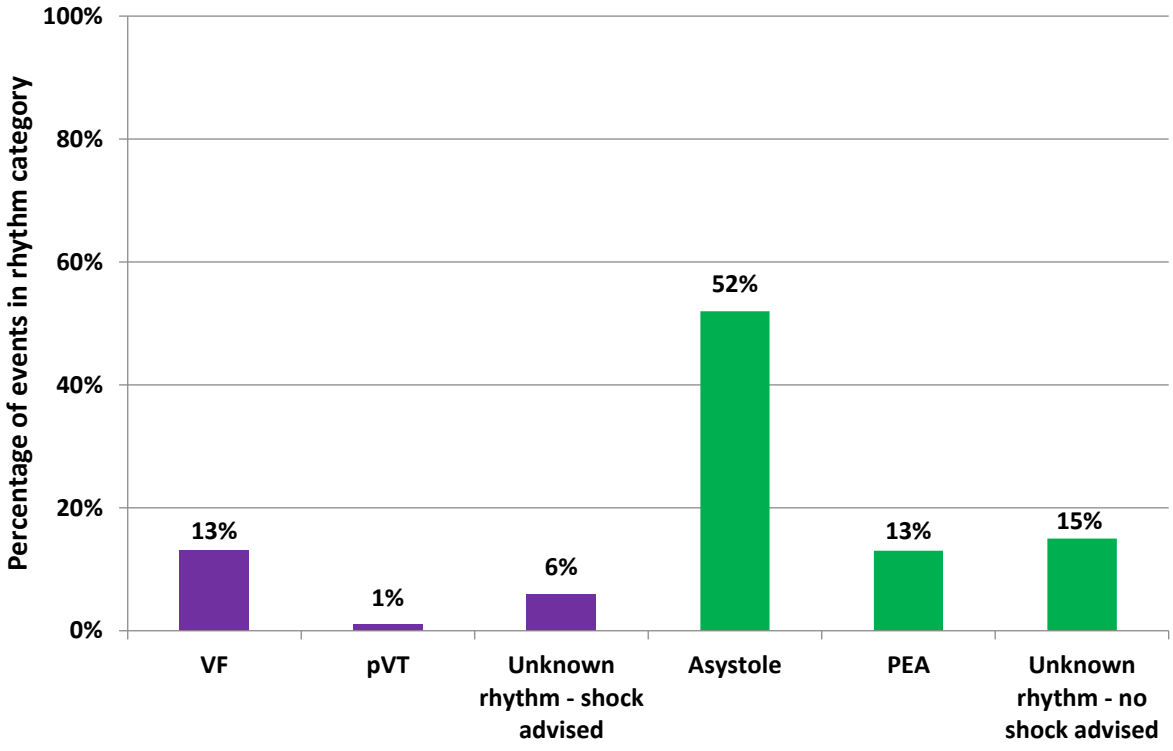
Figure 4: Witnessed status (n= 2,580)



3.10 First Monitored Rhythm

- 19% of cases were in a shockable rhythm at time of first rhythm analysis (n=509/2,638), (Figure 5)
- The initial rhythm was asystole in 52% of cases (n=1,344/2,569).

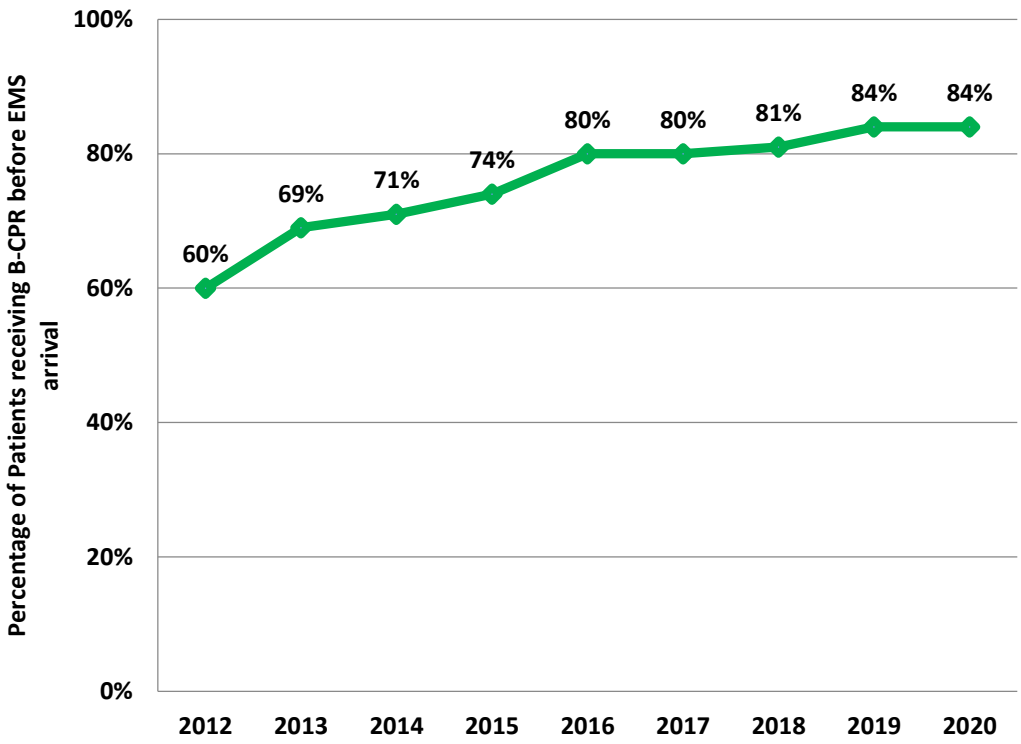
Figure 5: First monitored rhythm (n=2,569)



3.11 Bystander CPR

- Bystander CPR was attempted in 84% of non-EMS witnessed* cases (n=1,940/2,296).

Figure 6: Percentage of patients receiving B-CPR before EMS arrival, years 2012 – 2020



*i.e. non-EMS witnessed cases

- In the subgroup of patients that had a bystander witnessed collapse (n=1,287) 87% (n=1,272) of patients had bystander CPR (B-CPR) attempted.
- A higher proportion of cases in a rural area received B-CPR (n=902/1,075) compared to an urban area (n=972/1,360) (84% vs. 71%; p<0.001)
- A higher proportion of cases in a private location received B-CPR compared to a public location (78% vs. 67%; p<0.001).

The proportion of cases that received public B-CPR decreased from 73% in 2019 to 67% in 2020.

3.12 Mechanical CPR

OHCAR is unable to report on the use of Mechanical CPR due to the unavailability of reliable data, OHCAR is working with NAS to address this issue.

3.13 Defibrillation

- 29% of cases had defibrillation attempted (n=755/2,634)
- 6.1% of defibrillation attempts were made pre-EMS arrival (n=161/2,638) (Fig. 7)
- Of the 755 patients who had defibrillation attempted:
  - 220 had the pads applied pre-EMS arrival (29%)
  - 161 had the first shock delivered pre-EMS arrival (21%) (Figure 8).

Figure 7: Defibrillation attempts pre-EMS arrival – all cases

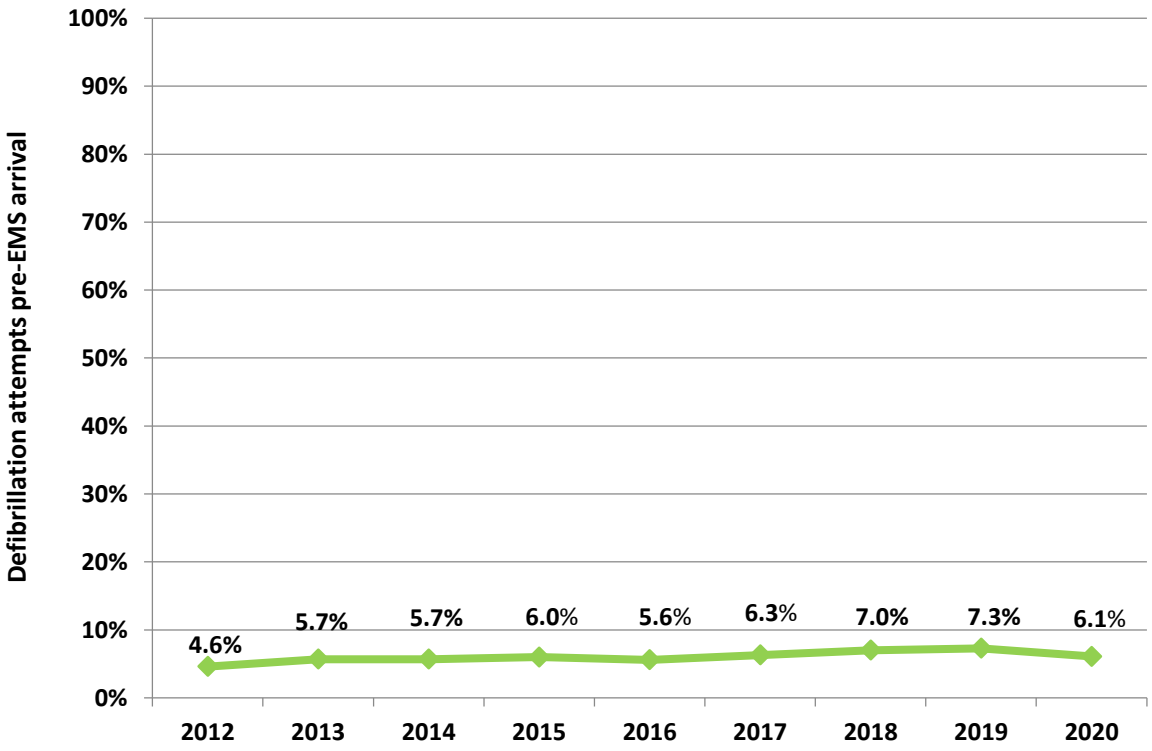
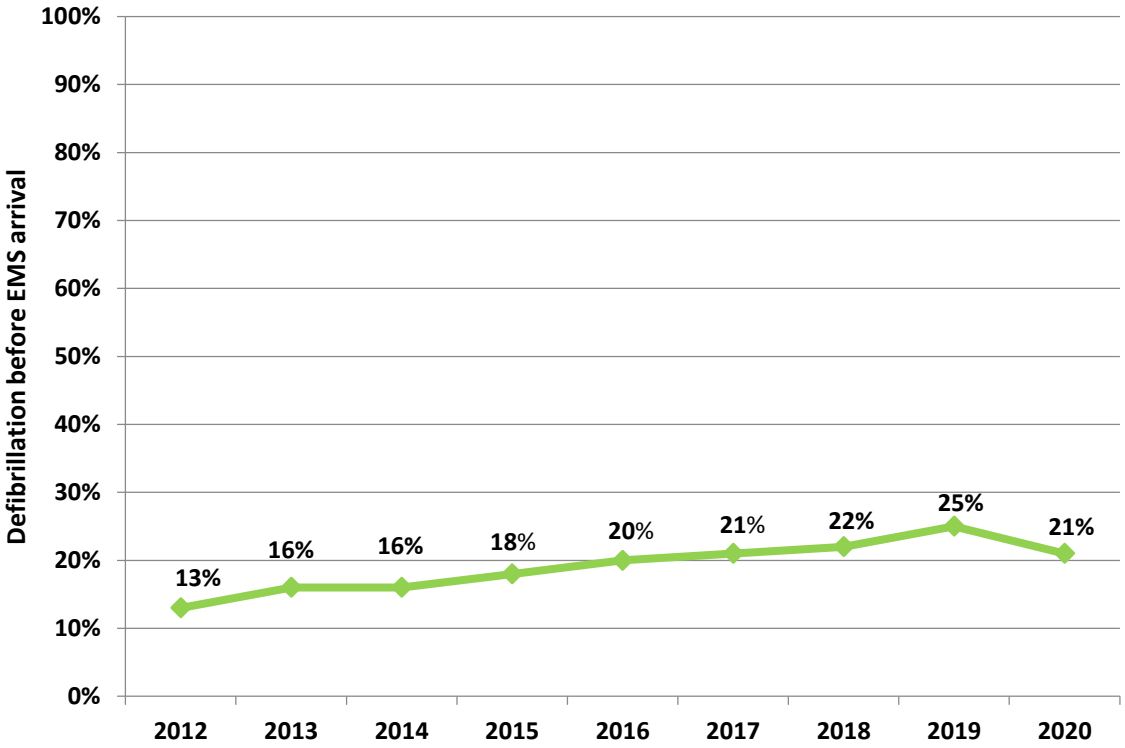


Figure 8: Defibrillation attempts pre-EMS arrival – of those with attempted defibrillation



First shock delivered before EMS arrival

In the 161 cases where first shock was delivered before EMS arrival, the identity of the person who delivered the first shock was as follows:

- Members of the general public (28%, n=45)
- Doctors (17%, n=27)
- Basic Life Supporter (BLS) / Cardiac First Responder (CFR) trained (17%, n=28)
- Local Fire services (12%, n=20)
- Voluntary Services (10%, n=16)
- Nurses (10%, n=16)
- Others including Occupational First Aiders and members of An Garda Síochána (6%, n=9).

Conversion to shockable rhythm during resuscitation

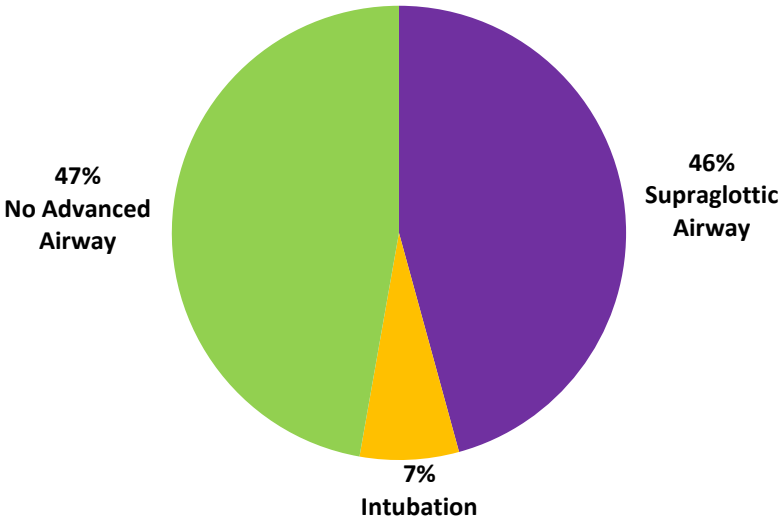
A total of 255 patients converted to a shockable rhythm during resuscitation. Of these:

- 54% were initially in asystole (n=137/255)
- 25% were initially in PEA (n=63/255, rhythm type not specified for the remainder.

3.14 Advanced Airway Adjuncts

- In 53% of cases, advanced airway adjuncts were used, i.e. supraglottic airway device or intubation (n=1,356/2,569), (Figure 9).

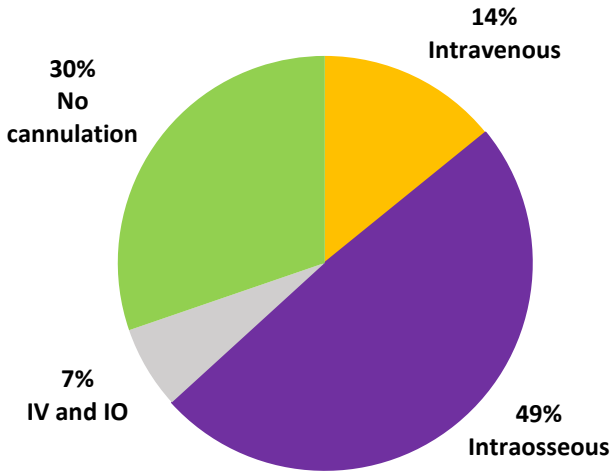
Figure 9: Adjunct airway management (n=2,569



3.15 Cannulation

- 70% of cases had cannulation performed (n=1,851/2,638)
  - 49% of cases had intraosseous cannulation (n=1,276/2,600)
  - 14% had intravenous only cannulation (n=368/2,600)
  - 6% had a combination of both techniques (n=169/2,600)
  - 30% of cases were not cannulated (n=787/2,600) (Figure 10).

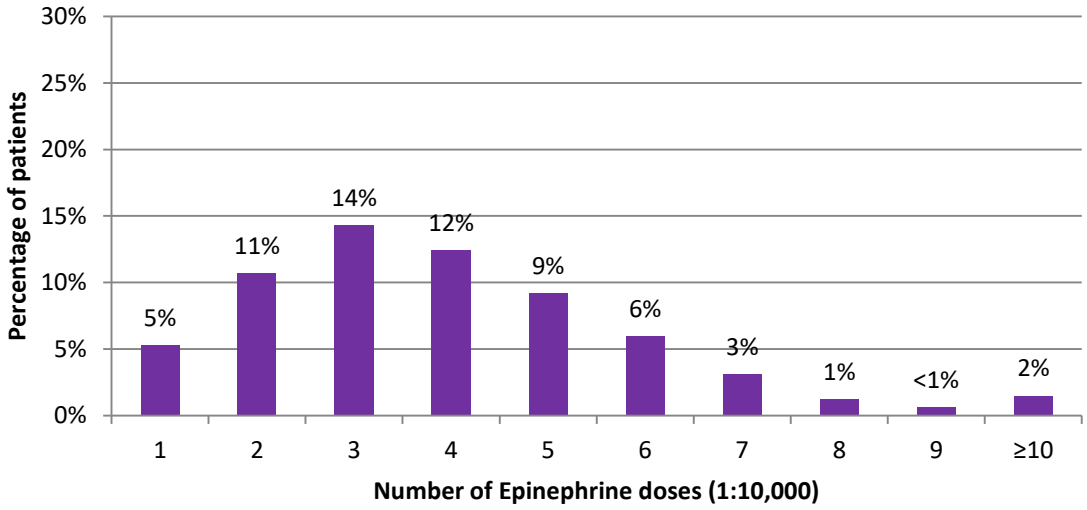
Figure 10: Cannulation method (n=2,600)



3.16 Cardiac Arrest Medication

- 64% of cases had epinephrine administered (n=1,700/2,638); the number of doses given ranged from 1 to 16 (Figure 11).

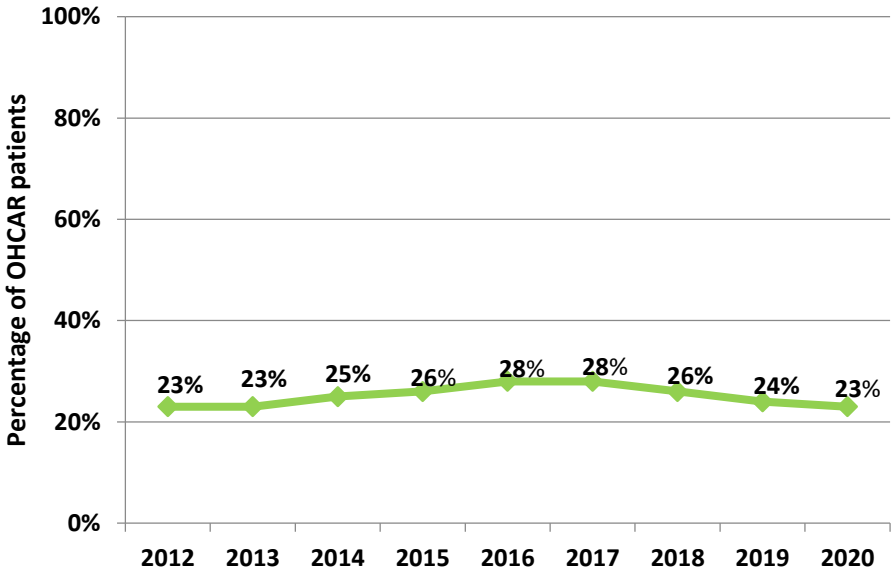
Figure 11: Percentage of Epinephrine doses (1:10,000) (n=1,700)



3.17 ROSC at any stage

- 23% of cases had ROSC before hospital arrival (n=600/2,638) (Figure 12)
- 26% of cases that occurred in an urban area achieved ROSC, compared with 18% in a rural area (n=365/1,401 vs. n=194/1,080 p<0.001).

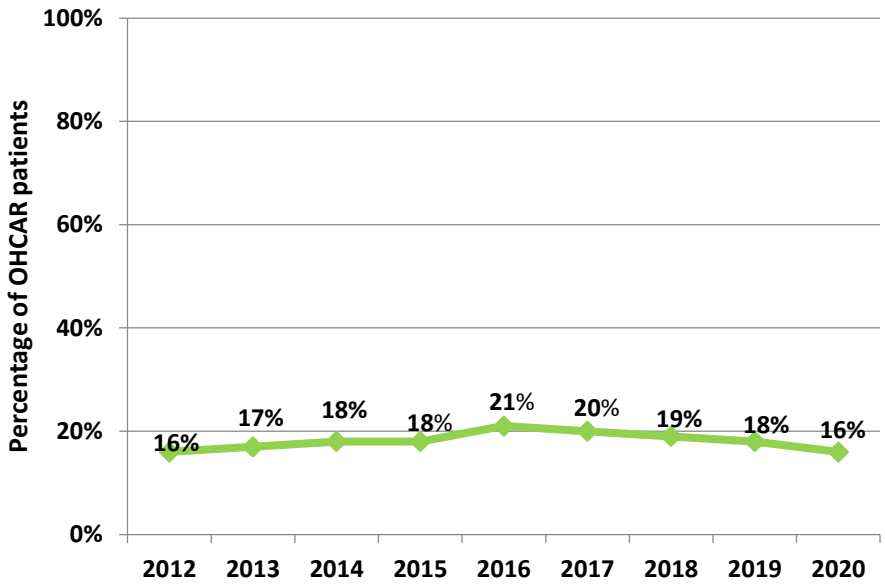
Figure 12: ROSC at any stage pre-hospital, all patients. Years 2012 – 2020



3.18 ROSC on Hospital arrival

- 16% of cases had ROSC on Hospital arrival (n=414/2,630) (Figure 13)
- ROSC on Hospital arrival was more likely to occur in an urban area compared to a rural area (18% vs. 12%; p<0.001).

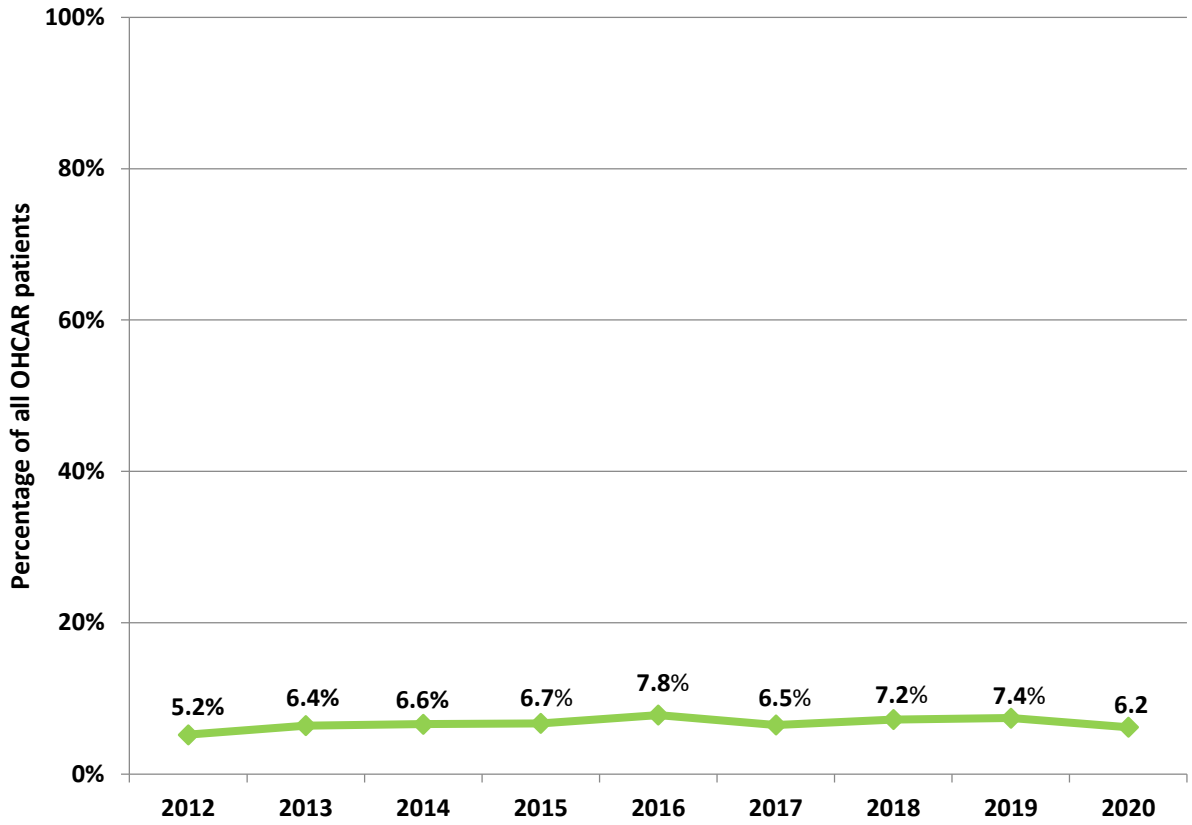
Figure 13: ROSC at Hospital arrival, all patients. Years 2012 – 2020



3.19 Discharged alive from Hospital

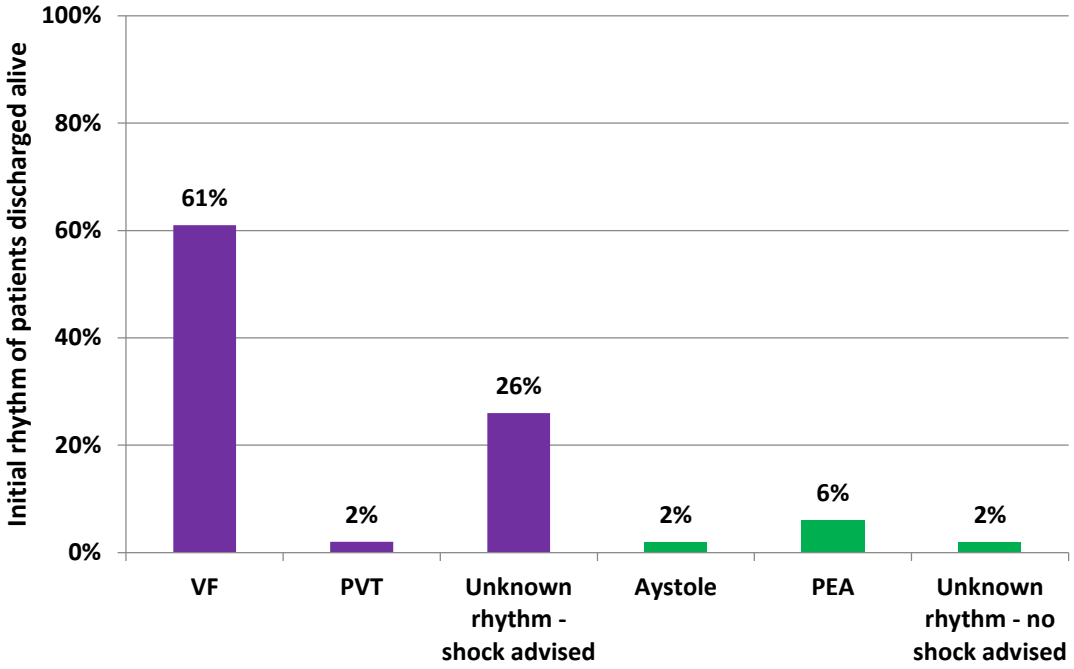
- A total of 164 patients were discharged alive from hospital (6.2%) (Figure 14). Data on 11 patients who were transported to hospital could not be obtained.

Figure 14: Percentage survival to discharge, all patients. Years 2012 – 2020 (n=1,357/20,270)



- Surviving patients were younger (median age 59 years, IQR 47 – 68) than non-surviving patients (median age 69 years, IQR 53 – 79 years, (p≤0.001))
- The presumed aetiology was medical for 92% of survivors
- Survival in the presumed medical aetiology group was 7% (n=151/2,198) compared with 3% (n=13/429) in the non-medical group (p=0.002)
- 14% of patients who collapsed in a public location survived (n=68/472), compared to 8% of patients that collapsed in a private location (n=96/1,155), (p≤0.001)
- 6.2% of patients who collapsed in an urban area survived (n=86/1,393), compared to 5.9% of patients that collapsed in a rural area (n=60/1,019), (p≤0.001)
- 89% of survivors had an initial shockable rhythm (n=146/164), (Figure 15)
- 11% of survivors had an initial non-shockable rhythm (n=18/164).

Figure 15: Percentage of survivors categorised by first analysed rhythm



- In the non-EMS witnessed group of survivors (n=123)
  - 85% had a witnessed arrest
  - 90% received bystander CPR
  - 45% (n=56), had defibrillator pads applied prior to EMS arrival
  - 36% (n=45) were shocked before EMS arrival
- In the EMS-witnessed group, 15% of patients survived (n=39/260)
- In the subgroup of EMS-witnessed patients that were adults, with presumed medical aetiology, with an initial shockable rhythm, 56% of patients survived (n=37/66).

3.20 Neurological function at discharge

The CPC [12] Score is an instrument developed to assess both traumatic and anoxic cerebral injuries. It is classified as a core Utstein data element for recording of cardiac arrest patients. The CPC score has five categories:

(1). Good cerebral performance

(2). Moderate disability: conscious, sufficient cerebral function for independent living

(3). Severe disability: dependent on others for daily support

(4). Coma or vegetative state

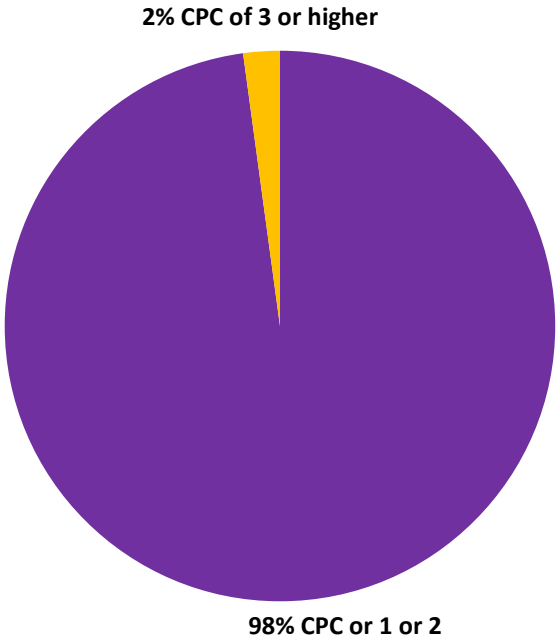
(5). Brain death.

CPC score data was available for 140 surviving patients (Figure 16):

- 98% (n=137) had a score of 1 or 2
- 2% (n=3) had a score of 3 or higher

N.B. Data on CPC score was missing for 13% of surviving patients.

Figure 16: CPC score at discharge



3.21 OHCA in the under 35 age group

- 9% of cases were recorded as being <35 years of age (n=235/2,626)
    - 39% were of a presumed medical aetiology (n=92/235)
    - 11% were caused by trauma (road traffic accident, gunshot, stabbing, crush injuries or fall) (n=27/235)
    - 19% of cases resulted from a drug overdose (n=44/235)
    - 65% of cases were unwitnessed (n=152/229)
    - 10% were initially shockable (n=23/235)
    - 7.2% survived to Hospital discharge (n=17/235)

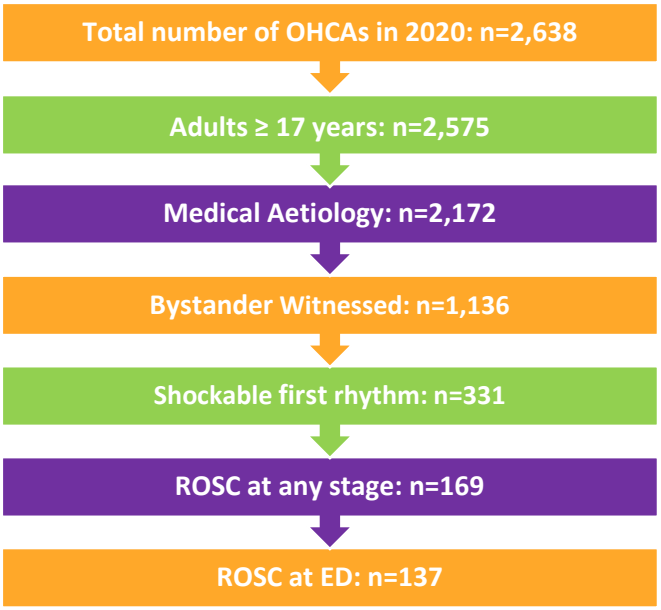
3.22 Utstein Comparator Subset

The Utstein comparator subset includes the following subgroup of patients

- Adult (i.e. older than seventeen years)
- Presumed medical aetiology
- Bystander witnessed arrest
- First monitored rhythm shockable.

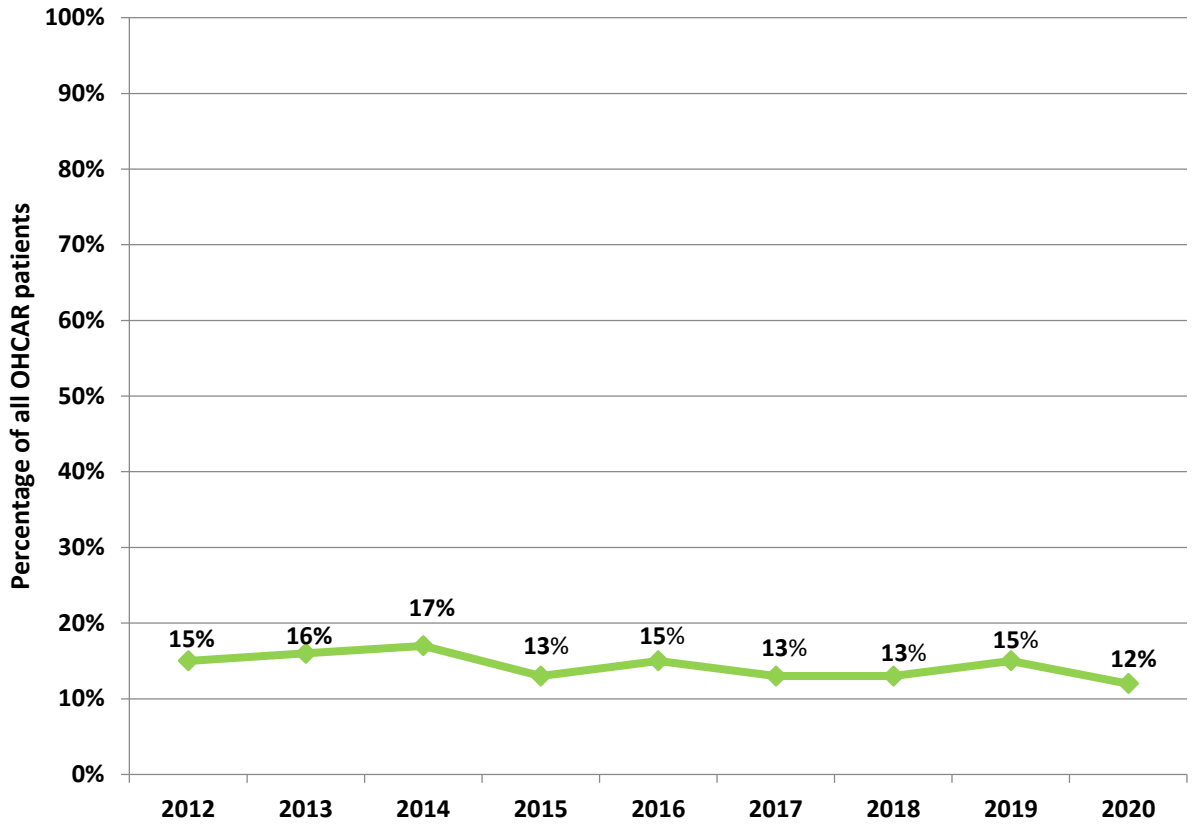
There is wide variation of circumstances around a cardiac arrest and patient characteristics. Using the Utstein comparator subset allows for a more standardised comparison of patient outcomes between systems and time periods (Figure 17).

Figure 17: Flowchart of the 2020 Utstein comparator subset and ROSC outcomes



In 2020, the Utstein comparator subset included 331 patients and accounted for 12% of all OHCAR cases (331/2,638).

Figure 18: Utstein comparator subset 2012 – 2020

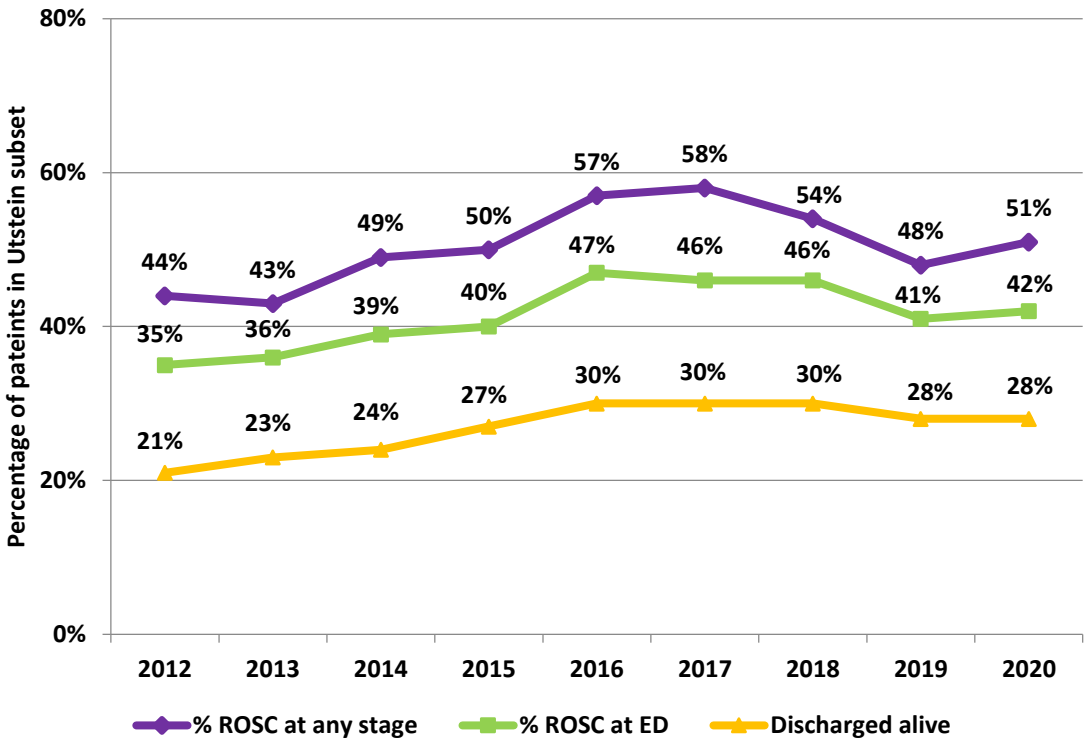


3.23 Utstein Comparator Subset Outcomes

- **51%** of patients (n=169/331) achieved ROSC at some stage before hospital arrival
- **42%** of patients (n=137/329 had ROSC on arrival at the ED
- **28%** of patients (n=92/327) were discharged alive from hospital (Figure 18)
- Of the survivors for whom CPC was available, **97%** had a CPC score of one or two (n=77/79).

N.B. Data on CPC score was missing for 16% of surviving Utstein patients.

Figure 19: Outcomes in the Utstein comparator subset, years 2012 – 2020



Case Characteristics

- Of those patients who collapsed in a public location, 38% survived (n=39/103) compared to 24% in a private location (n=53/224) (p=0.012)
- 94% of cases were recognised as cardiac arrest at the time of ambulance dispatch (n=311/330)
- Bystander CPR was performed on 96% of survivors
- 47% of the patients who survived had defibrillation attempted before ambulance service arrival (n=42/92). The estimated median time from 'time of collapse' to 'time of first shock administered' was 6 minutes (n=21/42, IQR 3 – 10).

Chapter 4

4.0 Conclusion

Since the last OHCAR Annual Report, the Bystander CPR remains at 84%. The use of mechanical CPR has reduced from 52% to 47% of all OHCAR cases.

Defibrillation before EMS arrival was attempted in only 6.1% of all patients. In the subgroup pf patients who had defibrillation attempted (n=755), there has been a reduction in attempted defibrillation before EMS arrival, from 25% to 21%. ROSC before hospital arrival was 23%, ROSC on arrival at hospital was 16% and the absolute number of patients discharged alive from hospital has not increased for the first time since 2012.

In the Utstein group the ROSC prior to hospital arrival was 51%, ROSC at Hospital arrival was 42% and discharge alive was 28%. In line with previous years, surviving patients were more likely to be younger, have a presumed medical aetiology, have collapsed in a public, urban location, have a witnessed arrest, present in a shockable rhythm, and received bystander CPR.

4.1 OHCAR Research

Research projects approved by OHCAR Steering Group July 2020 – July 2021:

Principal Investigator	Title
Prof. Gerard Bury	Medical Emergency Responder Integration and Training Three (MERIT3). Utilisation of a novel Ambulance Service alerting system to prompt GP first responders to nearby cardiac arrests
Prof. Andrew Murphy	Out of Hospital Cardiac Arrests in Ireland- National Time Series Analysis
Dr. Thomas Barry	Linking and harnessing health and population data to improve outcomes in Out-of-Hospital Cardiac Arrest in Ireland
Joan McCormack	Impact of COVID19 on Heart Attack Care in Ireland
Dr. Enrico Baldi	EuropeaN Study about AED Use by lay REscuers (ENSURE)
Martin Quinn	International Liaison Committee on Resuscitation Out-of-Hospital Cardiac Arrest survey 2

4.2 Future developments in OHCAR

OHCAR has worked closely with NAS in implementing an electronic PCR system. This is fully operational and has facilitated a more efficient and streamlined transfer of data relating to an OHCA. Information is available to OHCAR immediately, aiding data processing and the generation of reports to service users in a short timeframe. OHCAR is in the process of updating its database which will be aligned with the electronic PCR system.

From July 1st 2020, a project to assess the feasibility of collecting data on out-of-hospital cardiac arrest incidents which are attended by the EMS but where resuscitation is NOT attempted was carried out. This data collection stream was considered feasible and these incidents will be included in subsequent OHCAR annual reports.

Chapter 5

Acknowledgements

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NAS - Emergency Medical Technicians, Paramedics, Advanced Paramedics, Aero-Medical Crews, National Emergency Operations Centre, NAS Clinical Information Manager, NAS Clinical Development Manager, NAS National Director, NAS Medical Director

DFB - Emergency First Responders, Emergency Medical Technicians, Paramedics, Advanced Paramedics, East Region Communications Centre, District Officer EMS Support, Assistant Chief Fire Officer EMS Operations, DFB Medical Director

First Responders - All CFR Group Members, First Aid Responders, Irish Coast Guard, An Garda Síochána, Order of Malta, St. John Ambulance, Red Cross, Private Ambulance Crews, Voluntary First Responders, Bystanders, Doctors, Nurses, Local Fire Services, and Civil Defence

Hospitals - Beaumont - Dr. Peader Gilligan; ED consultant, Dr. Muhammad Abdal, Dr. Ahmed Babiker Hassan Mohamed, & Dr. Phyllis Lockner. Cavan General - Rosemarie Hastie, RTO. Cork University - Linda Evans, CHAIR Registration Officer, Kathleen Twomey, RTO. Our Lady of Lourdes, Drogheda - Rosemarie Faulkner and Claire Jordan, RTOs. Galway University - Caroline Ryder, Applications/MIS Manager. James Connolly Memorial, Blanchardstown - Anne Regan, RTO. University Hospital Kerry - James Hanlon, RTO. Letterkenny University - Anne McShane, ED Respiratory Nurse, and the Death Registration Office. Limerick University - Marie O'Hora, Anne McNulty & Ciara Cahill, RTOs. Mater Misericordiae University - Bernie Morgan and Orla Gaynor, RTOs. Mayo University - Liz Casey, R & EWS RTO. Midland Regional Hospital, Mullingar Hospital - Patricia Geraghty, ED secretary. Naas General - Angie Reilly, RTO. Our Lady's, Navan - Regina Tevlin, RTO. Portiuncula University - Joe Fahy, RTO. South Tipperary General – Liz Ryan & Aoife Walsh, RTOs. Sligo University - Deirdre Staunton. RTO. St. James's - Brendan O'Hagan. St. Vincent's University - Statistics Department. Tallaght University - Catherine Markham, Cardiology Audit Nurse. University Hospital Waterford - Mary Ivory, RTO. Wexford General - Frances Hore, ED secretary

National Office of Clinical Audit – Aisling Connolly, Communications & Events Lead.

References

1. World Health Organisation; https://covid19.who.int/ (accessed 15.09.2021).
2. International Liaison Committee on Resuscitaion; https://www.ilcor.org/covid-19
3. HSE Guidance on DNR decision making during COVID; https://www.hse.ie/eng/about/who/qid/other-quality-improvement-programmes/assisteddecisionmaking/hse-guidance-regarding-cpr-and-dnar-decision-making-during-covid-19-v-1-11.pdf
4. Department of Health and Children. Reducing the Risk: A Strategic Approach. The Report of the Task Force on Sudden Cardiac Death. 2006.
5. Department of Health and Children. Changing Cardiovascular Health: National Cardiovascular Health Policy 2010-20192010.
6. Irish Association for Emergency Medicine, College of Emergency Medicine. The National Emergency Medicine Programme: A Strategy to improve Safety, Quality Access and Value in Emergency Medicine Ireland.2012.
7. Gräsner J-T, Wnent J, et al. *Survival after out-of-hospital cardiac arrest in Europe – Results of the EuReCa TWO study.* Resuscitation 2020; 148: p. 218-226.
8. Wnent J, Masterson S, Gräsner J-T, et al. EuReCa ONE–27 Nations, ONE Europe, ONE Registry: a prospective observational analysis over one month in 27 resuscitation registries in Europe–the EuReCa ONE study protocol. Scandinavian journal of trauma, resuscitation & emergency medicine 2015;23:1-6.
9. Gräsner J-T, Lefering R, Koster RW, et al. EuReCa ONE - 27 Nations, ONE Europe, ONE Registry. A prospective one month analysis of out-of-hospital cardiac arrest outcomes in 27 countries in Europe. *Resuscitation* 2016; 105: 188-95.
10. Perkins GD, Jacobs IG, Nadkarni VM, et al. Cardiac arrest and cardiopulmonary resuscitation outcome reports: update of the Utstein Resuscitation Registry Templates for Out-of-Hospital Cardiac Arrest: a statement for healthcare professionals from a task force of the International Liaison Committee on Resuscitation (American Heart Association, European Resuscitation Council, Australian and New Zealand Council on Resuscitation, Heart and Stroke Foundation of Canada, InterAmerican Heart Foundation, Resuscitation Council of Southern Africa, Resuscitation Council of Asia); and the American Heart Association Emergency Cardiovascular Care Committee and the Council on Cardiopulmonary, Critical Care, Perioperative and Resuscitation. Circulation 2015;132:1286-300.

11. Masterson S, Jensen M. Complying with Utstein guidelines: Comprehensive case identification in the Irish national out-of-hospital cardiac arrest register. Resuscitation. Jan 16 2016, doi:10.1016/j.resuscitation.2015.12.018.
12. Rittenberger JC, Raina K, Holm MB, Kim YJ, Callaway CW. Association between Cerebral Performance Category, Modified Rankin Scale, and Discharge Disposition after Cardiac Arrest. *Resuscitation*. 2011;82(8):1036-1040. doi:10.1016/j.resuscitation.2011.03.034.
13. Berdowski J, Berg RA, Tijssen JG, Koster RW. Global incidences of out-of-hospital cardiac arrest and survival rates: systematic review of 67 prospective studies. Resuscitation 2010;81:1479-87.
14. Pallant, J. (2007). SPSS – Survival Manual. 3rd Edition, Mc Graw Hill.
15. Census 2016 Summary Results - Part 1, retrieved from; http://www.cso.ie/en/releasesandpublications/ep/p-cp1hii/bgn/
16. Atwood C, Eisenberg MS, Herlitz J, Rea TD. Incidence of EMS-treated out-of-hospital cardiac arrest in Europe. Resuscitation 2005;67:75-80.

Appendix 1

OHCAR Steering Group

The OHCAR Steering Group is responsible for ensuring that the aims of OHCAR are fulfilled and for advising on its organisation and direction. The Steering Group includes representatives from all four supporting organisations, and met four times between July 2020 to July 2021.

The membership at November 2021 is:

- Professor Conor Deasy, Professor of Emergency Medicine, University College Cork and Consultant in Emergency Medicine, Cork University Hospital (OHCAR Chair)
- Professor Gerard Bury, Director, UCD Centre for Emergency Medical Science
- Dr. John Dowling, General Practitioner, North West Immediate Care Programme
- Mr. Joe Fahy, Resuscitation Officer, Portiuncula University Hospital
- Dr. Joseph Galvin, Consultant Cardiologist, Mater Hospital
- Mr. David Hennelly, Clinical Development Manager, National Ambulance Service, HSE
- Siobhán Masterson PhD, National Project Manager, Out-of-Hospital Cardiac Arrest Strategy, National Ambulance Service Lead for Clinical Strategy & Evaluation & Honorary Research Senior Lecturer, NUI Galway
- Dr. David Menzies, Chair, CFR Ireland & Consultant in Emergency Medicine, St Vincent's University Hospital & Clinical Lead, Emergency Medical Science, UCD, Centre for Emergency Medical Science
- Professor Andrew Murphy, Foundation Professor, Discipline of General Practice, NUI Galway
- Professor Cathal O'Donnell, Clinical Director, National Ambulance Service
- Mr. Michael O'Reilly, Assistant Chief Fire Officer, Dublin Fire Brigade
- Mr. Martin O'Reilly, District Officer, EMS Support Officer, Dublin Fire Brigade
- Bridget Clarke, National Ambulance Service Lead for Out of Hospital Cardiac Arrest Strategy & Associated Programmes
- Mr. Martin Quinn, OHCAR Manager, National Ambulance Service.

Appendix 2

OHCAR Meetings, Representations and Publications

- The Regional Health Forum Committee; Western Area, "OHCAR Annual Report 2018", Sligo, 28th January 2020
- Virtual Respond 2020, Online, 24th October 2020
- Virtual ERC Conference, Online, 22nd – 24th October 2020

Publications using OHCAR data or supported by OHCAR

Masterson S, Jensen M. Complying with Utstein guidelines: Comprehensive case identification in the Irish national out-of-hospital cardiac arrest register. Resuscitation. Jan 16 2016, https://doi:10.1016/j.resuscitation.2015.12.018.

Moran PS, Teljeur C, Masterson S, O'Neill M, Harrington P, Ryan M. Cost-effectiveness of a national public access defibrillation programme. Resuscitation 2015; 91: 48-55.

Masterson, S., P. Wright, C. O'Donnell, A. Vellinga, A. W. Murphy, D. Hennelly, B. Sinnott, J. Egan, M. O'Reilly, J. Keaney, G. Bury & C. Deasy (2015) Urban and rural differences in out-of-hospital cardiac arrest in Ireland. Resuscitation, 91, 42-7.

Grasner, J. T. & S. Masterson (2015) EuReCa and international resuscitation registries. Current Opinion in Critical Care, 21, 215-9.

Wnent J*, Masterson S*, Gräsner JT, Böttiger BW, Herlitz J, Koster RW, Rosell Ortiz F, Tjelmeland I, Maurer H, Bossaert L. EuReCa ONE - 27 Nations, ONE Europe, ONE Registry: a prospective observational analysis over one month in 27 resuscitation registries in Europe - the EuReCa ONE study protocol. *Scandinavian Journal of Trauma, Resuscitation and Emergency Medicine* 2015, 23(1), p.1. *Joint lead authors

Masterson, S., A. Vellinga, P. Wright, J. Dowling, G. Bury & A. W. Murphy (2015a) General practitioner contribution to out-of-hospital cardiac arrest outcome: A national registry study. European Journal of General Practice, 21, 131-7.

Nishiyama, C., S. P. Brown, S. May, T. Iwami, R. W. Koster, S. G. Beesems, M. Kuisma, A. Salo, I. Jacobs, J. Finn, F. Sterz, A. Nurnberger, K. Smith, L. Morrison, T. M. Olasveengen, C. W. Callaway, S. D. Shin, J. T. Grasner, M. Daya, M. H. Ma, J. Herlitz, A. Stromsoe, T. P. Aufderheide, S. Masterson, H. Wang, J. Christenson, I. Stiell, D. Davis, E. Huszti & G. Nichol (2014) Apples to apples or apples to oranges? International variation in reporting of process and outcome of care for out-of-hospital cardiac arrest. Resuscitation, 85, 1599-609.

Gräsner, JT., Böttiger, BW and Bossaert, l. "EuReCa ONE–ONE month–ONE Europe–ONE goal." Resuscitation 10.85 (2014): 1307-1308.

Masterson, S., P. Wright, J. Dowling, D. Swann, G. Bury & A. Murphy (2011) Out-of-hospital cardiac arrest (OHCA) survival in rural Northwest Ireland: 17 years' experience. Emergency Medicine Journal, 28, 437-8.

Masterson, S., J. Cullinan, B. McNally, C. Deasy, A. Murphy, P. Wright, M. O'Reilly & A. Vellinga (2016) Out-of-hospital cardiac arrest attended by ambulance services in Ireland: first 2 years' results from a nationwide registry. Emergency Medicine Journal, 33, 776-781.

Masterson S, Cullinan J, Teljeur C, and Vellinga A. (2016) The Spatial Distribution of Out-of-Hospital Cardiac Arrest and the Chain of Survival in Ireland: A Multi-Class Urban-Rural Analysis'. *Irish Geography*, 49(2), 1-27, https://doi: 10.2014/igj.v49i2.1232.

Tanner, R., S. Masterson, M. Jensen, P. Wright, D. Hennelly, M. O'Reilly, A. W. Murphy, G. Bury, C. O'Donnell & C. Deasy (2017) Out-of-hospital cardiac arrests in the older population in Ireland. Emergency Medicine Journal. https://doi:10.1136/emermed-2016-206041.

Masterson S, Teljeur C, Cullinan J, Murphy AW, Deasy C, Vellinga A (2017). The Effect of Rurality on Out-of-Hospital Cardiac Arrest Resuscitation Incidence: An Exploratory Study of a National Registry Utilizing a Categorical Approach. The Journal of Rural Health; epub.

Wnent, Jan; Masterson, Siobhan; Gräsner, Jan-Thorsten; Böttiger, Bernd W.; Eggeling, Johanna; Herlitz, Johan; Koster, Rudolph W.; Lefering, Rolf; Maurer, Holger; Rosell Ortiz, Fernando; Perkins, Gavin D.; Tjelmeland, Ingvild; Bossaert, Leo.EuReCa TWO – A prospective

observational analysis over three month in 29 cardiac arrest and resuscitation registries in 29 European countries – The EuReCa TWO study protocol. Anästh Intensivmed 2017;85:506-511. https://doi: 10.19224/ai2017.506

Masterson, Siobhán; Teljeur, Conor; Cullinan, John; Murphy, Andrew; Deasy, Conor; Vellinga, Akke; Out‐of‐hospital cardiac arrest in the home: Can area characteristics identify at‐risk communities in the Republic of Ireland? International Journal of Health Geographics (2018) 17:6 https://DOU: 10.1186/s12942-018-0126-z

T. Barry, N. Conroy, M. Headon, M. Egan, M. Quinn, C. Deasy, G. Bury; The MERIT 3 project: Alerting general practitioners to cardiac arrest in the community. Resuscitation 121 (2017) 141–146

Siobhán Masterson, Bryan McNally, John Cullinan, Kimberly Vellano, Joséphine Escutnaire, David Fitzpatrick, Gavin D. Perkins, Rudolph W. Koster, Yuko Nakajima, Katherine Pemberton, Martin Quinn, Karen Smith, Bergþór Steinn Jónsson, Anneli Strömsöe, Meera Tandan, Akke Vellinga; Out-of-hospital cardiac arrest survival in international airports. Resuscitation 127 (2018) 58–62

Siobhán Masterson, Anneli Strömsöe, John Cullinan, Conor Deasy, Akke Vellinga; Apples to apples: can differences in out-of-hospital cardiac arrest incidence and outcomes between Sweden and Ireland be explained by core Utstein variables? Scandinavian Journal of Trauma, Resuscitation and Emergency Medicine (2018) 26:37

H. Maurer, S. Masterson, IB. Tjelmeland, JT. Gräsner, R. Lefering, BW. Böttiger, L. Bossaert, J. Herlitz, RW. Koster, F. Rosell-Ortiz, GD. Perkins, J. Wnent; When is a bystander not a bystander anymore? A European Survey. *Resuscitation* (2018), https://doi.org/10.1016/j.resuscitation.2018.12.009

Kylie Dyson, Siobhan P. Brown, Susanne May, Karen Smith, Rudolph W. Koster, Stefanie G. Beesems, Markku Kuisma, Ari Salo, Judith Finn, Fritz Sterz, Alexander Nürnberger, Laurie J. Morrison, Theresa M. Olasveengen, Clifton W. Callaway, Sang Do Shin, Jan-Thorsten Gräsner, Mohamud Daya, Matthew Huei-Ming Ma, Johan Herlitz, Anneli Strömsöe, Tom P. Aufderheide,

Siobhán Masterson, Henry Wang, Jim Christenson, Ian Stiell, Gary M. Vilke, Ahamed Idris, Chika Nishiyama, Taku Iwami, Graham Nichol; International variation in survival after out-of-hospital cardiac arrest: A validation study of the Utstein template. *Resuscitation* (2019), https://doi.org/10.1016/j.resuscitation.2019.03.018

Kieran Henry, Jeffrey Mulcaire, Alice Kirby, Aine Cotter, Siobhan Masterson, Cathal O'Donnell, Conor Deasy; Out-of-hospital cardiac attest quality of life follow-up study of survivors in Munster, Ireland. Irish Journal of Medical Science (2020) https://doi.org/10.1007/s11845-020-02189-4

Iris Oving, Corina de Graaf, Siobhan Masterson, Rudolph Koster, Aeilko Zwinderman, Remy Stieglis, Hajriz AliHodzic, Enrico Baldi, Susanne Betz, Diana Cimpoesu, Fredrik Folke, Dennis Rupp, Frederico Semeraro, Anatolij Truhlar, Hanno Tan, Marieke Blom; European first responder systems and differences in return of spontaneous circulation and survival after out-of-hospital cardiac arrest: A study of registry cohorts, The Lancet Regional Health – Europe (2020), https://doi.org/10.1016/j.lanepe.2020.100004

Tomas Barry, Mary Headon, Martin Quinn, Siobhan Masterson, Conor Deasy, Gerard Bury; General practice and cardiac arrest community first response in Ireland, Resuscitation Plus (2021), https://dx.doi.org/10.1016/j.resplu.2021.100127

Baldi, E.; Grieco, N.B.; Ristagno, G.; Alihodžić, H.; Canon, V.; Birkun, A.; Cresta, R.; Cimpoesu, D.; Clarens, C.; Ganter, J.; Markota, A.; Mols, P.; Nikolaidou, O.; Quinn, M.; Raffay, V.; Ortiz, F.; Salo, A.; Stieglis, R.; Strömsöe, A.; Tjelmeland, I.; Trenkler, S.; Wnent, J.; Grasner, J.; Böttiger, B.; Savastano, S.; The Automated External Defibrillator: Heterogeneity of Legislation, Mapping and Use across Europe. New Insights from the ENSURE Study. J. Clin. Med. 2021, 10, 5018. https://doi.org/10.3390/jcm10215018

Health Service Executive; Guidance Regarding Cardiopulmonary Resuscitation and DNAR Decision-Making during the COVID-19 Pandemic (2020) https://www.hse.ie/eng/about/who/qid/other-quality-improvement-programmes/assisteddecisionmaking/hse-guidance-regarding-cpr-and-dnar-decision-making-during-covid-19-v-1-11.pdf

Appendix 3

OHCAR Utstein Comparator Subset 2020 – Regional Results

Figure 1: Number of OHCAR patients in the Utstein group by region (n=331)

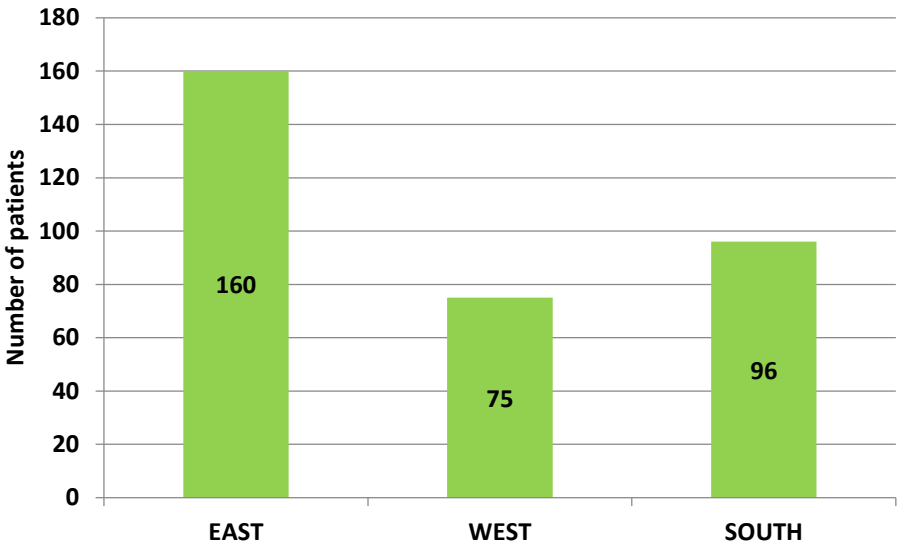

Figure 2: Dispatcher recognition of cardiac arrest at time of ambulance dispatch (Utstein), (n=330):

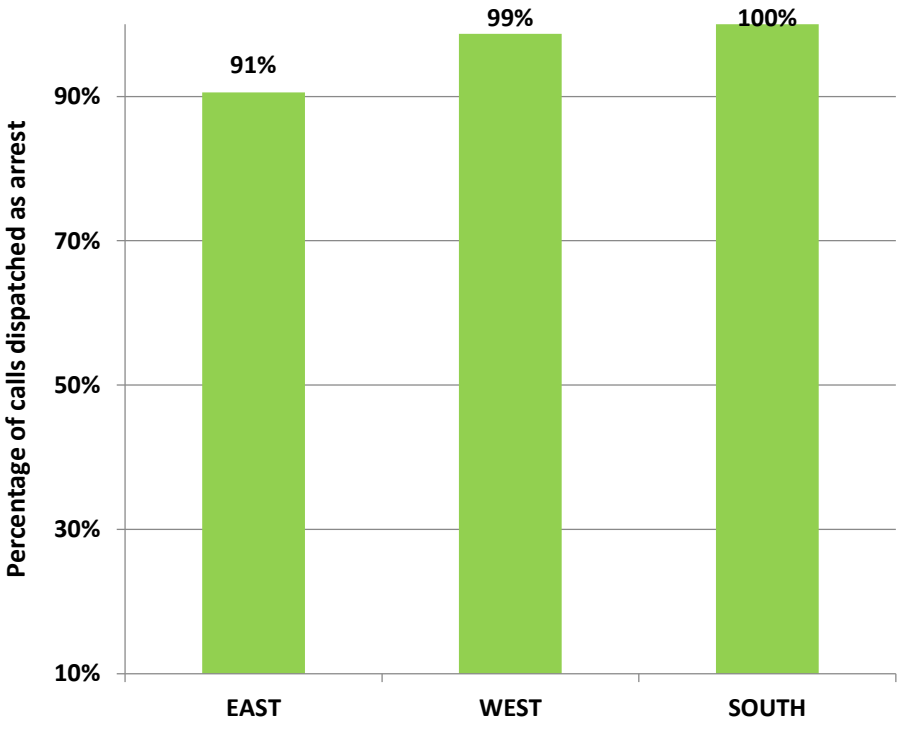

Figure 3: Percentage of Utstein cases with bystander CPR: