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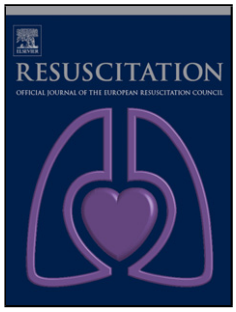

Out-of-hospital Cardiac Arrest across the World: First Report from the International Liaison Committee on Resuscitation (ILCOR)

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Out-of-hospital Cardiac Arrest across the World: First Report from the International Liaison Committee on Resuscitation (ILCOR)

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ABSTRACT

Background: Since development of the Utstein style recommendations for the uniform reporting of cardiac arrest, increasing numbers of national and regional out-of-hospital cardiac arrest (OHCA) registries have been established worldwide. The International Liaison Committee on Resuscitation (ILCOR) created the Research and Registries Working Group and aimed to systematically report data collected from these registries.

Methods: We conducted two surveys of voluntarily participating national and regional registries. The first survey aimed to identify which core elements of the current Utstein style for OHCA were collected by each registry. The second survey collected descriptive summary data from each registry. We chose the data collected for the second survey based on the availability of core elements identified by the first survey.

Results: Seven national and four regional registries were included in the first survey and nine national and seven regional registries in the second survey. The estimated annual incidence of emergency medical services (EMS)-treated OHCA was 30.0 to 97.1 individuals per 100,000 population. The combined data showed the median age varied from 64 to 79 years and more than half were male in all 16 registries. The provision of bystander cardiopulmonary resuscitation

(CPR) and bystander automated external defibrillator (AED) use was 19.1% to 79.0% in all registries and 2.0% to 37.4% among 11 registries, respectively. Survival to hospital discharge or 30-day survival after EMS-treated OHCA was 3.1% to 20.4% across all registries. Favourable neurological outcome at hospital discharge or 30 days after EMS-treated OHCA was 2.8% to 18.2%. Survival to hospital discharge or 30-day survival after bystander witnessed shockable OHCA ranged from 11.7% to 47.4% and favourable neurological outcome from 9.9% to 33.3%.

Conclusion: This report from ILCOR describes data on systems of care and outcomes following OHCA from nine national and seven regional registries across the world. We found variation in reported survival outcomes and other core elements of the current Utstein style recommendations for OHCA across nations and regions.

Key words

Out-of-hospital cardiac arrest, Utstein template, Epidemiology, Resuscitation, Registry

MAIN TEXT

Introduction

Out-of-hospital cardiac arrest (OHCA) is a global health issue. The incidence of emergency medical services (EMS)-treated OHCA has been reported as 40.6 per 100,000 person-years in Europe, 47.3 in North America, 45.9 in Asia, and 51.1 in Australia.[1] Patient outcomes after OHCA vary substantially by region but are generally poor, suggesting opportunities for improvement.[2–6]

A high-quality registry with a uniform collecting system enables better understanding of the epidemiology of OHCA, facilitates inter-system and intra-system comparisons, identifies knowledge gaps, supports clinical research, and may help to influence performance and improve survival after OHCA.[7] The Utstein style was originally developed to facilitate uniform reporting of terms and to standardise definitions for out-of-hospital resuscitation.[7] The International Liaison Committee on Resuscitation (ILCOR) has revised and updated the Utstein style recommendations for OHCA in 2004 and 2014.[8–11]

Along with the development and revisions of the Utstein style recommendations, increasing numbers of OHCA registries have been established in Europe,[2, 12–17] North

America,[18–21] Asia,[22, 23] and Oceania[24, 25]. However, to date, there has been a paucity of systematic collection and reporting of data from existing registries.[26] A Research and Registries Working Group was created by ILCOR with the objective of establishing a system to collect descriptive data on systems of care and outcomes following OHCA from registries across the world, which could potentially enable benchmarking and possibly improvement of patient outcomes from cardiac arrest.[27] This article describes the initial findings of the working group.

Methods

The ILCOR Research and Registries Working Group conducted three face-to-face meetings and five teleconferences between January 2016 and September 2017, and a consensus was reached for a strategy to collect data from participating registries. Participation in this project by registries was voluntary. We conducted two surveys of the participating national and regional registries (**Table 1**): the first survey aimed to describe which of the Utstein elements were collected by each registry and the second survey aimed to report summary data from each registry to describe characteristics of OHCAs in the nation or region. The first survey assessed which core elements of the latest Utstein style recommendation for OHCA in 2014 were collected by each registry,[10, 11] and identified any discrepancies in the data collection process. Based on the availability of the data elements in each registry in the first survey, we chose the elements for the second survey and descriptively reported the 2015 summary data from each registry. If 2015 data were not available, the most recently available data were reported. The data from the Rescu Epistry in Toronto, Canada were extracted from a published paper.[28] We included population-based registries which covered all EMS resuscitation attempted OHCAs in each area. We defined a national registry as one that collected data from the whole nation or

multiple regions within one nation designated to be representative of the whole nation; other registries were designated as regional registries. We calculated the estimated annual incidence of EMS-treated OHCA at each registry, using the annual number of EMS-treated OHCA as the numerator and the total population of covered area as the denominator. When a registry collected type of bystander cardiopulmonary resuscitation (CPR), i.e., conventional CPR with rescue breathing or chest compression-only CPR, we presented proportion of patients who received each type of bystander CPR among EMS resuscitation attempted OHCAs in the registry. Similarly, when a registry collected data on the application of an AED and shock delivery by a bystander, we presented the proportion of those who had an AED applied and a shock delivered. When we calculated the proportion of those who received bystander CPR, had an AED applied, and received an AED shock, we excluded EMS-witnessed OHCA from the denominators because those with EMS-witnessed OHCA did not have the opportunity to have these bystander interventions. Survival outcomes were reported for both all EMS-treated OHCAs and bystander-witnessed shockable OHCAs. Favourable neurological outcome was defined as Cerebral Performance Category (CPC) 1 or 2, or modified Rankin Scale ≤3 following the Utstein recommendation.[10, 11] We used a secure electronic database, Research Electronic Data

146 Capture (RED Cap) for data collection for both surveys and data management.[29]

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Results

Eighteen registries were invited to participate in the first survey. Seven national and 4 regional OHCA registries responded and are included in the first survey results. Thirty-seven registries were invited to participate in the second survey, 14 did not respond to the invitation, and 7 were not population-based registries. As a result, 9 national and 7 regional registries are included in the second survey results. (**Table 1**) Based on the differences between the elements measured by each registry and the core elements of Utstein 2014 OHCA style recommendations, we excluded the following elements from the secondary survey: dispatcher-identified cardiac arrest, resuscitation not attempted (because of a written *do not attempt cardiopulmonary resuscitation* order or obvious death), targeted temperature management (TTM) indication, vasopressin use, reperfusion (e.g. percutaneous coronary intervention, PCI) attempted, and type and timing of reperfusion. (**Supplemental Table**)

We report the results of the second survey, summary data of core elements of the Utstein template from each participating registry in 2015 in **Tables 2-5**, **and Figure 1**. All registries were population-based and national registries included between 25.0% to 100% of the national population. (**Table 2**) The estimated annual incidence of EMS-treated OHCA ranged from 30.0

to 97.1 individuals per 100,000 population. Seven registries recorded dispatcher CPR instructions, which ranged from 1.6% to 54.7% of EMS-treated OHCAs across registries. Median age varied from 64 to 79 years and more than half of patients were male in all registries. (**Table 3**) All registries reported witness status and 37.0% to 69.8% of OHCAs were witnessed by a bystander. Fourteen registries recorded the location of OHCA and 51.6% to 85.3% occurred at home. All registries reported bystander CPR and 11 registries reported bystander AED use (**Figure 1 and Table 3**). The provision of bystander CPR ranged from 19.1% to 79.0% in all registries (**Figure 1**). Six registries recorded types of bystander CPR. Chest compression-only bystander CPR was provided for 15.4% to 46.9% of OHCA. Bystander AED use varied from 2.0% to 37.4% and shock delivered from 0.5% to 7.2% (**Table 3**). Fourteen registries recorded the cause of cardiac arrests, and the proportion of documented as medical cause ranged from 52.0% to 95.2%. Thirteen registries recorded EMS response time, the interval from incoming call to the time that the first emergency response vehicle stopped at the scene, with median intervals ranging from 5 to 11 minutes (**Table 4**).

All registries recorded survival to hospital discharge or 30-day survival and 11 registries recorded favourable neurological outcome at hospital discharge or 30 days after EMS-treated

OHCA (**Table 5**). Survival to hospital discharge or 30-day survival after EMS-treated OHCA varied from 3.1% to 20.4% across all registries. Favourable neurological outcome at hospital discharge or 30 days after EMS-treated OHCA varied from 2.8% to 18.2%. Survival to hospital discharge or 30-day survival after bystander witnessed shockable OHCA ranged 11.7% to 47.4% and favourable neurological outcome was from 9.9% to 33.3%.

Discussion

This ILCOR report presents a descriptive summary of OHCA systems of care and outcome data from 16 national and regional OHCA registries across the world. The data show that most registries are collecting and reporting core elements of the Utstein data set.[10, 11] There is a 6.6-fold difference in survival to hospital discharge or 30-day survival (3.1% to 20.4%) and a 6.5-fold difference in favourable neurological outcome at hospital discharge or at 30 days (2.8% to 18.2%) after EMS-treated OHCA across the registries. Importantly, direct comparison of the outcomes between registries is not appropriate because of multiple confounders: system, dispatch, patient, and process that are measured and unmeasured in the latest Utstein style templates. For example, core elements of the latest Utstein templates do not include the following data points which contribute to the denominator for population-based EMS-treated cases, although some of these factors are listed as supplemental elements of system in the Utstein template; (1) criteria to dispatch EMS providers, (2) how prehospital advance directives are handled by dispatcher, (3) legislation prescribing who is mandated to receive resuscitation, (4) determination of futility before starting resuscitation, and (5) determination of who should be transported with continued treatment and who should have their resuscitative efforts terminated at the scene.[10, 11] Each

one of these factors at system-level contributes to the determination of who receives an EMS response and if EMS initiates resuscitative effort through a standardized endpoint. The difference in these factors across registries could also explain the observed large variation in the estimated incidence of EMS-treated OHCA in our report. Prior work from the Resuscitation Outcomes Consortium, a multicentre research network in the United States and Canada showed that there was a variability (23.9% to 100%) in the proportion of patients where resuscitation was initiated by EMS in EMS-assessed OHCA across 129 EMS agencies in North America.[30] Future efforts are warranted to capture these known factors that contribute to the denominator for population-based EMS-treated cases across registries. Furthermore, a recent analysis of data from 12 OHCA registries showed that Utstein factors could explain only about half of the variation in OHCA survival between settings.[26]

We also reported a 4.1-fold difference in survival to hospital discharge or 30-day survival (11.7% to 47.4%) and a 3.4-fold difference in favourable neurological outcome at hospital discharge or at 30 days (9.9% to 33.3%) for patients with bystander witnessed shockable OHCA. This population can be considered to represent a less heterogeneous group than all EMS-treated OHCAs and is a better comparator of system efficacy as recommended in the Utstein style.[10,

11] The potential mechanisms of the variation in outcomes after bystander-witnessed shockable OHCA across registries include differences in each Utstein OHCA element: system, dispatch, patient, and process. Importantly, we observed a 4.1-fold difference in the provision of bystander CPR (19.1% to 79.0%) and a 18.7-fold difference in bystander AED use (2.0% to 37.4%). As these interventions are linked closely with favourable outcomes[23, 31–37] and modifiable, it is important to recognize these differences by regions and optimize the provision of bystander CPR and AED use in all communities. This might include widespread training in CPR and AED use[14, 38], media campaigns[39], dispatcher CPR instructions[40–42], and new technologies using a mobile phone to direct nearby registered lay rescuers to the scene.[43–45]

We found discrepancies between measured elements in each registry and core elements of the latest Utstein style recommendations for OHCA (e.g., 6/11 registries measured "resuscitation not attempted [because of a written *do not attempt cardiopulmonary resuscitation* decision or obvious death]", 6/11 "dispatcher identified cardiac arrest", 3/11 "targeted temperature management indication", 7/11 "reperfusion attempted"), which is consistent with a previous report.[46] Most of these infrequently measured core elements of the Utstein style recommendations are variables that were newly adopted in 2014, implying that the updated

Utstein templates have yet to be widely implemented. As new post cardiac arrest treatments have been developed [47, 48], many of the recently adopted core and supplemental elements include in-hospital post-resuscitation interventions, which implies the need for a comprehensive data collecting system to link prehospital and in-hospital elements. This will necessitate collaboration between EMS systems and medical institutions. The Utstein elements predict survival but account for only a modest portion of regional variation in patient outcome after OHCA, suggesting that there are other unmeasured factors that are contributing to the outcome variability.[5, 49, 50] To capture these important yet to be measured factors, future research should identify these factors and subsequent revision of the Utstein style recommendation is required.

The data generated by this global registry report help with understanding the current epidemiology of OHCA and inform quality improvement. We plan to increase the number of participating registries to enable more comprehensive reporting of systems of care and outcomes following OHCA throughout the world. Continuity is also important to assess secular trends of outcomes and evaluate effectiveness of various interventions. We also plan to conduct a similar

project for in-hospital cardiac arrest following the Utstein style recommendations for in-hospital cardiac arrests.[51–54]

This report has several limitations. First, denominators may not have been standardized across all elements. We intended to include all EMS-resuscitated OHCAs in the denominators, but the failure to include all of these OHCAs in the denominators may account at least partially for the large variation in outcomes such as survival, bystander CPR, and AED use across registries. Second, we were not able to include all core and supplemental elements of the latest Utstein style recommendation for OHCA in 2014 because these data were not available in all registries. Third, although most registries provided data for 2015, the year of data collection was different in two of the registries. Fourth, most of the registries which participated in this survey are from high income nations/regions, so our results may not be applicable to low income nations/regions.

Conclusion

Based on the Utstein style recommendations for OHCA reporting, we described the data collected on systems of care and outcomes following OHCA from 9 national and 7 regional registries across the world. We found variation in patient outcomes and in other core elements of the latest Utstein style recommendations for OHCA across nations and regions, suggesting opportunities for improvements in data definitions and reporting system.

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Conflict of interest

JPN is Editor-in-Chief, GDP and JS are Editors of Resuscitation.

The rest of authors report no conflicts of interest related specifically to this manuscript.

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449

450 **Figure legend**

451 Figure. Proportion of provision of bystander cardiopulmonary resuscitation among patients with

452 emergency medical services resuscitation attempted out-of-hospital cardiac arrest*

453 * We excluded EMS-witnessed out-of-hospital cardiac arrest

454

Table 1. Participating registries

Name of registry	Country	Response to the first survey	Response to the second survey
National/International Registries*			
Cardiac Arrest Registry to Enhance Survival (CARES)	United States	✔	✔
Danish Cardiac Arrest Registry	Denmark		✔
Norwegian Cardiac Arrest Registry	Norway	✔	✔
Swedish Cardiac Arrest Registry	Sweden	✔	
Out-of-hospital Cardiac Arrest Outcomes (OHCAO)	United Kingdom	✔	✔
Australian Resuscitation Outomes Consortium (Aus-ROC)	Australia		✔
Australian Resuscitation Outomes Consortium (Aus-ROC)	New Zealand		✔
Pan-Asian Resuscitation Outcomes Study (PAROS)	Singapore	✔	✔
Pan-Asian Resuscitation Outcomes Study (PAROS)	South Korea	✔	✔
Utstein Japan	Japan	✔	✔
Regional Registries			
Saving Hearts in Arizona Registry & Education (SHARE)	United States	✔	✔
Rescu Epistry	Canada		✔
Helsinki Cardiac Arrest Registry	Finland	✔	✔
Pavia Cardiac Arrest Registry (Pavia CARe)	Italy	✔	✔
Ticino Registry of Cardiac Arrest	Switzerland		✔
Pan-Asian Resuscitation Outcomes Study (PAROS)	Tainan City, Taiwan	✔	✔
Sudden Death Expertise Center registry (SDEC)	Paris		✔

*We defined a national registry as one aiming for nationwide coverage and an international regisry as one including more than one country.

Table 2. Summary data in Utstein core elements (system and dispatch)

Name of registries	Country	Total population of covered area of the registry	Proportion of population in covered area of the registry among the country's population, %	Population-based	Annual number of atttempted resuscitaion in 2015	Estimated Incidence of EMS treated OHCA per 100,000 population	Annual number of dispatcher CPR instruction, n (%)
National/International Registries							
Cardiac Arrest Registry to Enhance Survival (CARES)	United States	85,000,000	25.0%	Yes	52,902	62.2	N/A
Danish Cardiac Arrest Registry*	Denmark	5,627,235	100.0%	Yes	4,053	72.0	N/A
Norwegian Cardiac Arrest Registry	Norway	4,793,741	93.0%	Yes	2,298	47.9	N/A
Out-of-hospital Cardiac Arrest Outcomes (OHCAO)	United Kingdom	54,646,932	83.9%	Yes	28,914	52.9	N/A
Australian Resuscitation Outomes Consortium (Aus-ROC)	Australia	15,215,358	64.0%	Yes	7,120	46.8	N/A
Australian Resuscitation Outomes Consortium (Aus-ROC)	New Zealand	4,595,720	100.0%	Yes	2305	50.2	N/A
Pan-Asian Resuscitation Outcomes Study (PAROS)	Singapore	5,535,000	100.0%	Yes	2,322	42.0	1,250 (53.8)
Pan-Asian Resuscitation Outcomes Study (PAROS)	South Korea	51,069,375	97.0%	Yes	27,656	54.2	10,432 (37.7)
Utstein Japan	Japan	127,094,745	100.0%	Yes	123,421	97.1	67,488 (54.7)
Regional Registries							
Saving Hearts in Arizona Registry & Education (SHARE)	United States	6,931,071	2.2%	No	4,467	64.4	71 (1.6)
Rescu Epistry†	Canada	6,600,000	19.0%	Yes	3,610	54.7	N/A
Helsinki Cardiac Arrest Registry	Finland	639,222	12.0%	Yes	225	35.2	120 (53.3)
Pavia Cardiac Arrest Registry (Pavia CARe)	Italy	547,435	1.0%	Yes	490	89.5	50 (10.2)
Ticino Registry of Cardiac Arrest	Switzerland	350,363	10.0%	Yes	247	70.5	N/A
Pan-Asian Resuscitation Outcomes Study (PAROS)	Tainan City, Taiwan	1,885,390	8.0%	Yes	1,599	84.8	261 (16.3)
Sudden Death Expertise Center registry (SDEC)	Paris	6,800,000	10.0%	Yes	2,040	30.0	N/A

*Data in 2014

†Data in 2013

CPR denote cardiopulmonary resuscitation.

Table 3. Summary data for all EMS treated OHCA in Utstein core elements (patient)

Name of registries	Country	Age		Male, n (%)	Witnessed arrest, n (%)		Location, n (%)						AED use by bystander, n (%)‡		First monitored rhythm, n (%)	Pathogenesis, n (%)					
		Median (IQR)	Mean (SD)		Bystaner witnessed	EMS witnessed	Home/ residence	Industrial/ workplace	Sports/ recreation event	Public building	Educational institution	Assisted living/ nursing home	AED use	Shock delivered	Shockable	Medical	Trauma	Drug overdose	Drowning	Electrocution	Asphyxial
National/International Registries																					
Cardiac Arrest Registry to Enhance Survival (CARES)	United States	64 (52, 77)	62.5 (19.4)	32,255 (61.0)	19,558 (37.0)	6,346 (12.0)	36,733 (69.4)	N/A	880 (1.7)	3,780 (7.1)	N/A	5,679 (10.7)	2866 (6.2)	893 (1.9)	10,594 (20.0)	45,243 (85.5)	N/A	N/A	367 (0.7)	36 (0.1)	4,620 (8.7)
Danish Cardiac Arrest Registry*	Denmark	72 (61, 82)	N/A	2,535 (62.6)	1,808 (44.9)	472 (11.7)	2,866 (72.0)	N/A	N/A	N/A	N/A	N/A	N/A	119 (3.6)	724 (18.7)	N/A	N/A	N/A	N/A	N/A	N/A
Norwegian Cardiac Arrest Registry	Norway	N/A	66 (18.9)	1,532 (66.7)	1,183 (51.5)	292 (12.7)	1,402 (61.0)	62 (2.7)	34 (1.5)	N/A	N/A	253 (11.0)	256 (12.8)	N/A	575 (25.0)	1659 (72.2)	85 (3.7)	138 (6.0)	37 (1.6)	N/A	368 (16.0)
Out-of-hospital Cardiac Arrest Outcomes (OHCAO)	United Kingdom	72.6 (58.2, 82.7)	68.6 (19.2)	17,626 (63.3)	10,742 (46.6)	3,512 (15.2)	N/A	N/A	N/A	N/A	N/A	N/A	443 (2.5)	N/A	5,762 (21.3)	18,831 (92.3)	714 (3.5)	268 (1.3)	55 (0.3)	N/A	524 (2.6)
Australian Resuscitation Outomes Consortium (Aus-ROC)	Australia	65 (48, 78)	61.5 (21.2)	4,863 (68.3)	2,687 (38.0)	1,081 (15.2)	4,741 (66.6)	N/A	N/A	N/A	N/A	504 (7.1)	N/A	N/A	1,757 (25.1)	5,058 (71.0)	N/A	N/A	N/A	N/A	N/A
Australian Resuscitation Outomes Consortium (Aus-ROC)	New Zealand	66 (52, 77)	61.7 (20.6)	1,540 (66.8)	1,179 (51.1)	678 (29.4)	1,554 (67.4)	N/A	N/A	N/A	N/A	62 (2.7)	N/A	N/A	834 (36.5)	1,790 (77.7)	104 (4.5)	34 (1.5)	25 (1.1)	0	219 (9.5)
Pan-Asian Resuscitation Outcomes Study (PAROS)	Singapore	67 (56, 77)	65.7 (18.0)	1,512 (65.1)	1,253 (54.0)	212 (9.1)	1,649 (71.0)	N/A	36 (1.6)	204 (8.8)	N/A	83 (3.6)	90 (4.3)	34 (1.6)	377 (16.2)	2,211 (95.2)	96 (4.1)	N/A	14 (0.6)	1 (0.0004)	N/A
Pan-Asian Resuscitation Outcomes Study (PAROS)	South Korea	69 (54, 79)	65.0 (19.0)	17,884 (64.7)	10,472 (37.9)	1,911 (6.9)	16,089 (58.2)	N/A	397 (1.4)	296 (1.1)	N/A	1,793 (6.5)	518 (2.0)	117 (0.5)	3,591 (13.0)	20,309 (73.4)	3,719 (13.4)	458 (1.7)	381 (1.4)	N/A	2056 (7.4)
Utstein Japan	Japan	79 (67, 86)	75 (17.0)	70,421 (57.1)	51,125 (41.4)	9,862 (8.0)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1815 (1.6)	8,039 (6.5)	92,107 (74.6)	7,803 (6.3)	402 (0.3)	4,058 (3.3)	N/A	N/A
Regional Registries																					
Saving Hearts in Arizona Registry & Education (SHARE)	United States	64 (51, 76)	61 (20.9)	2,869 (64.2)	1,754 (39.3)	438 (9.8)	2,701 (60.5)	41 (0.9)	68 (1.5)	334 (7.5)	19 (0.4)	523 (11.7)	151 (3.7)	56 (1.4)	909 (20.3)	3,887 (87.0)	129 (2.9)	125 (2.8)	55 (1.2)	0 (0)	49 (1.1)
Rescu Epistry†	Canada	N/A	70.6 (16.1)	2,310 (64.0)	1,639 (45.4)	469 (13.0)	3,079 (85.3)	N/A	N/A	N/A	N/A	N/A	97 (3.1)	40 (1.3)	751 (20.8)	21,089 (88.3)	1,167 (4.9)	140 (0.6)	140 (0.6)	12 (0.05)	99 (0.4)
Helsinki Cardiac Arrest Registry	Finland	66 (57, 76)	67 (15.0)	161 (71.6)	157 (69.8)	29 (12.9)	116 (51.6)	3 (1.3)	N/A	31 (13.8)	N/A	18 (8.0)	13 (6.6)	9 (4.6)	85 (37.8)	117 (52.0)	6 (2.7)	6 (2.7)	3 (1.3)	0 (0)	7 (3.1)
Pavia Cardiac Arrest Registry (Pavia CARe)	Italy	79 (66, 85)	75 (15.0)	297 (60.6)	276 (56.3)	79 (16.1)	393 (80.2)	9 (1.8)	1 (0.2)	44 (9.0)	0	42 (8.6)	9 (2.2)	4 (1.0)	84 (17.1)	461 (94.1)	18 (3.7)	0 (0)	1 (0.2)	1 (0.2)	9 (1.8)
Ticino Registry of Cardiac Arrest	Switzerland	74 (62, 83)	70 (17.0)	159 (64.4)	131 (53.0)	25 (10.1)	167 (67.6)	4 (1.6)	8 (3.2)	53 (21.5)	0	15 (6.1)	83 (37.4)	16 (7.2)	45 (18.2)	198 (80.2)	12 (4.9)	5 (2.0)	4 (1.6)	0 (0)	24 (9.7)
Pan-Asian Resuscitation Outcomes Study (PAROS)	Tainan City, Taiwan	70 (54, 81)	66.1 (18.9)	1,018 (63.7)	913 (57.1)	89 (5.6)	1,164 (72.8)	52 (3.3)	8 (0.5)	18 (1.1)	9 (0.6)	71 (4.4)	N/A	N/A	127 (7.9)	1,370 (85.7)	229 (14.3)	4 (0.3)	4 (0.3)	0 (0)	20 (1.3)
Sudden Death Expertise Center registry (SDEC)	Paris	66 (54, 78)	65 (16.0)	1,344 (65.9)	1,274 (62.5)	251 (12.3)	1,511 (74.1)	N/A	N/A	N/A	N/A	N/A	35 (2.0)	N/A	552 (27.1)	N/A	N/A	N/A	N/A	N/A	N/A

*Data in 2014

†Data in 2013

‡We excluded EMS-witnessed OHCA from the denominators.

IQR denote interquartile range; SD: standard deviation; EMS: Emergency medical services; AED: automated external defibrillator.

Table 4. Summary data for all EMS treated OHCA in Utstein core elements (process)

Name of registries	Country	Median Time from call to EMS arrival on, minute, median (IQR)	Median Time from call to shock by EMS, minute, median (IQR)	The time interval from incoming call to initiation of EMS CPR[§], minute, median (IQR)	The time interval from incoming call to hospital arrival[§], minute, median (IQR)	TTM, n (%)		Drugs given, n (%)	
						Prehospital TTM	TTM (total)	Adrenaline	Amiodarone
National/International Registries									
Cardiac Arrest Registry to Enhance Survival (CARES)	United States	7. 1 (5.1, 10.0)	N/A	N/A	40.0 (31.4, 51.0)	5,224 (9.9)	10,174 (19.2)	38,617 (73.0)	4,843 (9.2)
Danish Cardiac Arrest Registry*	Denmark	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Norwegian Cardiac Arrest Registry	Norway	9 (6.0, 14.0)	N/A	N/A	N/A	0 (0)	N/A	1,402 (61.0)	299 (13.0)
Out-of-hospital Cardiac Arrest Outcomes (OHCAO)	United Kingdom	6.1 (3.8, 9.3)	N/A	N/A	N/A	N/A	N/A	17,125 (78.5)	2,116 (9.7)
Australian Resuscitation Outomes Consortium (Aus-ROC)	Australia	8.0 (6.0, 11.0)	N/A	N/A	65.0 (49, 88)	N/A	N/A	N/A	N/A
Australian Resuscitation Outomes Consortium (Aus-ROC)	New Zealand	9.0 (7.0, 13.0)	N/A	N/A	58.0 (43, 79)	N/A	N/A	N/A	N/A
Pan-Asian Resuscitation Outcomes Study (PAROS)	Singapore	9.0 (7.1, 11.5)	16.6 (12.7, 23.9)	12.3 (10.1, 15.5)	37.7 (33.0, 42.8)	N/A	133 (5.7)	1,866 (80.4)	27 (1.2)
Pan-Asian Resuscitation Outcomes Study (PAROS)	South Korea	7 (5.0, 10.0)	10 (9, 14)	9 (6, 12)	26 (21, 33)	N/A	627 (2.3)	N/A	N/A
Utstein Japan	Japan	7 (6.0, 9.0)	12 (9, 20)	9 (7, 12)	32 (26, 40)	N/A	N/A	21,712 (17.6)	N/A
Regional Registries									
Saving Hearts in Arizona Registry & Education (SHARE)	United States	5 (4, 7)	12 (8, 19)	9 (6, 11)	28 (23, 34)	33 (0.7)	454 (10.2)	3,570 (79.9)	277 (6.2)
Rescu Epistry[†]	Canada	6.5 (2.8)‡	N/A	N/A	N/A	N/A	2,101 (58.2)	N/A	N/A
Helsinki Cardiac Arrest Registry	Finland	8.5 (7.0, 10.0)	9.5 (8.0, 11.1)	8.5 (7.0, 10.0)	N/A	11 (4.9)	26 (11.6)	136 (60.4)	35 (15.6)
Pavia Cardiac Arrest Registry (Pavia CARe)	Italy	11 (8.0, 14.0)	15 (11, 26)	13 (10, 21)	66 (51, 87)	N/A	N/A	223 (45.5)	43 (8.8)
Ticino Registry of Cardiac Arrest	Switzerland	9 (6.0, 12.0)	11 (9, 15)	N/A	66(49, 79)	N/A	N/A	205 (83.0)	36 (14.6)
Pan-Asian Resuscitation Outcomes Study (PAROS)	Tainan City, Taiwan	6 (4.6, 8.1)	N/A	N/A	23 (19, 29)	N/A	N/A	60 (3.8)	0 (0)
Sudden Death Expertise Center registry (SDEC)	Paris	N/A	N/A	N/A	N/A	N/A	271 (13.3)	1,522 (74.6)	241 (16.7)

*Data in 2014

†Data in 2013

‡Reported mean (SD)

§Not in Utstein core element

IQR denote interquartile range; SD: standard deviation; EMS: Emergency medical services; AED: automated external defibrillator;

Table 5. Summary data in Utstein core elements (Outcome)

Name of registries	Country	All EMS treated OHCA including EMS witnessed, n (%)		Shockable bystander witnessed (EMS witnessed excluded), n (%)	
		Either discharged alive or 30 day survival	Good neurological outcome at hospital discharge or 30 days	Either discharged alive or 30 day survival	Good neurological outcome at hospital discharge or 30 days
National/International Registries					
Cardiac Arrest Registry to Enhance Survival (CARES)	United States	5,562 (10.5)	4,467 (8.4)	2,096 (33.4)	1,877 (29.9)
Danish Cardiac Arrest Registry *‡	Denmark	515 (12.7)	N/A	233 (47.4)	N/A
Norwegian Cardiac Arrest Registry‡	Norway	360 (15.7)	N/A	157 (43.6)	N/A
Out-of-hospital Cardiac Arrest Outcomes (OHCAO)	United Kingdom	1,962 (7.8)	N/A	761 (21.6)	N/A
Australian Resuscitation Outomes Consortium (Aus-ROC)	Australia	531 (11.0)	N/A	220 (31.0)	N/A
Australian Resuscitation Outomes Consortium (Aus-ROC)	New Zealand	316 (13.8)	N/A	175 (31.0)	N/A
Pan-Asian Resuscitation Outcomes Study (PAROS)	Singapore	121 (5.2)	3.2	53 (20.5)	37 (14.3)
Pan-Asian Resuscitation Outcomes Study (PAROS)	South Korea	1,875 (6.8)	3.9	833 (34.4)	659 (27.3)
Utstein Japan ‡	Japan	7,802 (6.3)	4,400 (4.6)	1,721 (33.8)	1,213 (23.8)
Regional Registries					
Saving Hearts in Arizona Registry & Education (SHARE)	United States	524 (12.0)	279 (6.2)	168 (31.0)	129 (23.8)
Rescu Epistry†	Canada	339 (9.4)	307 (8.5)	1,123 (31.1)	N/A
Helsinki Cardiac Arrest Registry	Finland	46 (20.4)	41 (18.2)	22 (34.9)	21 (33.3)
Pavia Cardiac Arrest Registry (Pavia CARe)	Italy	37 (7.6)	28 (5.7)	17 (29.8)	12 (21.1)
Ticino Registry of Cardiac Arrest	Switzerland	21 (8.5)	20 (8.1)	10 (24.4)	10 (24.4)
Pan-Asian Resuscitation Outcomes Study (PAROS)	Tainan City, Taiwan	50 (3.1)	44 (2.8)	13 (11.7)	11 (9.9)
Sudden Death Expertise Center registry (SDEC) ‡	Paris	144 (7.1)	140 (6.9)	92 (20.9)	88 (20.0)

*Data in 2014

†Data in 2013

‡Reported 30 day survival.

IQR denote interquartile range; SD: standard deviation; OHCA; out-of-hospital cardiac arrest; EMS: emergency medical services.