Out-of-Hospital Cardiac Arrest: From the Field to Discharge, A Contemporary Cohort

Lior Fisher MD[1,2,7], Ariel Furer MD[1,4,7], Ella Segal MD[5], Nadeem Massalha MD[2], Avinoah Ironi MD[1,7], Refael Strugo MD[3,6,7], Fernando Chernomordik MD[1,7], Shlomi Matetzky MD[1,7], and Roy Beigel MD[1,7]

[1]Leviev Heart Center, Sheba Medical Center, Tel Hashomer, Israel
[2]Department of Medicine B, Sheba Medical Center, Tel Hashomer, Israel
[3]Department of Emergency Medicine, Sheba Medical Center, Tel Hashomer, Israel
[4]Medical Corps, Israel Defense Forces, Ramat Gan, Israel
[5]School of Public Health, Tel Aviv University, Tel Aviv, Israel
[6]Magen David Adom, Tel Aviv, Israel
[7]Gray Faculty of Medical and Health Sciences, Tel Aviv University, Tel Aviv, Israel

ABSTRACT **Background:** Out-of-hospital cardiac arrest (OHCA) poses a considerable health burden and offers poor prognosis. Information about OHCA in Israel is scarce.

Objectives: To present a pilot registry of prehospital and in-hospital characteristics of patients with OHCA.

Methods: A descriptive study was conducted of consecutive adult patients with OHCA treated in the field by Magen David Adom (MDA) paramedics and treated at the Sheba Medical Center.

Results: The study included 99 patients with OHCA who were brought by MDA to the Sheba Medical Center. The median age was 79 years (IQR 67–89), 61% were male. In total, 69% of the events occurred at home, 16% at nursing facilities, 10% on streets, and 2% in public buildings. Most events (80%) were witnessed. Bystander-basic life support (BLS) was administered to 28%, 45% received BLS from an emergency medical service first responder. Automated external defibrillation was used in 40% of cases. In our cohort, 51 patients (51%) survived initial treatment in the emergency department (ED) and were hospitalized. Electrocardiography at arrival demonstrated ST-elevation in 22% of cases. Coronary angiography was performed in 19% (n=19) of patients, and 12% (n=12) underwent percutaneous intervention. Eventually, 26 patients (26%) survived to discharge with cerebral performance categories as follows: 13% (n=13) with cerebral performance, 10% (n=10) with moderate disability, and 3% (n=3) with severe disability or unconscious.

Conclusions: Among those admitted after surviving ED resuscitation, half survived to discharge. Most of those who survived hospitalization and were discharged with good neurological performance were young males..

IMAJ 2025; 27: 725–730

KEY WORDS: Out-of-hospital cardiac arrest (OHCA), sudden death, mortality, outcome, neurologic outcome

Out-of-hospital cardiac arrest (OHCA) is defined as the abrupt cessation of effective cardiac mechanical activity and the subsequent loss of systemic circulation outside a hospital environment. It presents as a significant global cause of mortality [1]. The precise public health burden of OHCA remains indeterminate, primarily due to the substantial number of cases not attended by emergency medical services (EMS) and the significant regional variations in reporting systems, incidence rates, and survival outcomes [2]. Globally, the weighted incidence estimates of EMS-treated OHCA per 100,000 person-years are as follows: 34.4 in Europe, 53.1 in North America, 59.4 in Asia, and 49.7 in Australia. The corresponding percentages for OHCA survival to discharge are 7.6% in Europe, 6.8% in North America, 3.0% in Asia, and 9.7% in Australia [3].

Despite the generally poor prognosis and the minor improvement in recent years, some regions report survival rates of 20–40% [4], with patients who receive bystander cardiopulmonary resuscitation (CPR) and reside in economically advanced countries being associated with a higher post-OHCA survival rate. The variability in survival rates for OHCA can be partially attributed to varying clinical definitions and efforts to optimize the local chain of emergency care. Recent measures have enhanced survival rates, such as training first responders, providing dispatcher-assisted CPR, and placing automated external defibrillators (AED) in public locations [5]. This trend is further emphasized by countries like Israel mandating bystander-basic life support (BLS) courses for all 16 year olds and ensuring low mandated AED availability in crowded places.

Although a few studies have investigated aspects of OHCA events in Israel [6-9], a comprehensive assessment of the continuum of prehospital and in-hospital clinical and event characteristics of patients with OHCA is lacking. Considering this, we present a pilot registry study outlining the comprehensive prehospital and in-hospital characteristics of patients who experienced OHCA and were transferred to a tertiary medical center in Israel.

PATIENTS AND METHODS

We conducted a retrospective analysis of consecutive adult patients presenting with OHCA and treated with CPR in the field by Magen David Adom (MDA), Israel's largest and primary EMS provider, in 2021. Subsequently, patients were transported to the Sheba Medical Center. Exclusion criteria included trauma-associated OHCA and other evident non-cardiopulmonary etiologies of OHCA (e.g., drowning and attempted suicide). The study was approved by the Sheba Medical Center Institutional Review Board (SMC-919822).

In a reported event of potential OHCA, local emergency dispatch receives a report, and the nearest available ambulance, first responders, and a paramedic-led mobile intensive care unit (MICU) are sent to the scene. As a national and organizational policy, CPR attempts are performed on every individual presenting with OHCA and bystander CPR, when possible, via phone instruction from the dispatcher. CPR is withheld in cases where death is evident to the EMS team or when a do-not-resuscitate order is appropriately given in advance.

Each case of OHCA transferred to the emergency department has a standardized record provided by the EMS operator. The record includes data such as event timeline, CPR attempts before EMS arrival, AED use, location of the event, and details observed by witnesses. In addition, clinical objective data are provided to the hospital staff, including the initially recorded cardiac rhythm, electrocardiogram tracings, vital signs, and other diagnostic information. At the time of the study, the main indication for primary PCI at our center was the presence of ST-elevation on the initial post-resuscitation electrocardiogram, or whether there was a suggested coronary etiology for the event. Patients undergoing targeted temperature management were treated to a targeted temperature set to 36°C for 24 hours with a focus of preventing hyperthermia. Data based on electronic medical record were collected in all cases of OHCA and included age, sex, co-morbidities, cardiovascular risk factors, initial diagnosis, electrocardiogram patterns, report of cardiac catheterization if performed, mortality, discharge status and destination, and cerebral performance category (CPC) index where favorable function was defined as CPC 1–2 and unfavorable function as CPC 3–4.

STATISTICAL ANALYSIS

Descriptive statistics were used to summarize the characteristics of the study population. Categorical variables were reported as numbers and percentages, while continuous variables were expressed as means with standard deviations or as medians with interquartile ranges, depending on their distribution. The relationships between categorical variables were analyzed using the chi-square test or Fisher's exact test, as appropriate. All statistical tests were two-sided. A *P*-value < 0.05 was considered statistically significant. Statistical analyses were performed using IBM Statistical Package for the Social Sciences statistics software, version 25 (SPSS, IBM Corp, Armonk, NY, USA).

RESULTS

In 2021, 99 adult patients with OHCA were transferred by MDA to the Sheba Medical Center. The median age was 79 years (IQR 67–89), with a predominance of males (61%). Patient characteristics and baseline parameters are presented in Table 1.

OUT-OF-HOSPITAL EVENT CHARACTERISTICS

Most of the events occurred at home (n=69, 69%). Witnessed arrests were recorded in 80 cases (80%). BLS was administered by bystanders or emergency medical technicians first responders in 72 cases (72%), and an AED was used in 40 cases (40%). EMS MICUs responded to 99 cases (100%). Manual shocks were administered in 31 cases (31%), with the first rhythm recorded on the ALS monitor being ventricular fibrillation (VF) in 20 cases (20%), VT in 3 cases (3.0%), asystole in 33 cases (33%), high-degree atrioventricular block or bradycardia in 2 cases (2.0%), and pulseless electrical activity (PEA) in 41 cases (41%).

HOSPITALIZATION CHARACTERISTICS

Of 99 patients, 51 (51%) survived initial treatment in the ED and were hospitalized: 25 (49%) in the intensive cardiac care unit (ICCU), 25 (49%) in the general internal medicine ward, and one (1%) in the ICU. Electrocardiogram at arrival showed ST-elevation in 22 cases (22%). Immediate coronary angiography was performed in 19 cases (19%). The reasons for immediate angiography included STEMI or other ischemic changes in 16 cases (16%), cardiogenic shock in 2 cases (2.0%), and other reasons in one case (1.0%). Percutaneous coronary inter-

Table 1. Patient characteristics

Total count		N=99
Median age, years (IQR)		79 (67–89)
Sex, male		60 (61%)
Prior MI		26 (26%)
Prior PCI		27 (27%)
Prior CABG		5 (5%)
Prior CVA		23 (23%)
Prior heart failure		26 (26%)
Hypertension		66 (67%)
Dyslipidemia		64 (65%)
Diabetes		41 (41%)
Out-of-hospital event characteristics		
Event location	Home	69 (69%)
	Public building	2 (2%)
	Street	10 (10%)
	Nursing facility	16 (16%)
	Other	2 (2%)
Witnessed cardiac arrest		Yes: 80 (80%)
BLS first treated patients		Yes: 28 (28%)
		Yes, EMT first responder: 44 (44%)
		No: 22 (22%)
		Missing: 5 (5%)
AED Use		40 (40%)
EMS, mobile ICU		99 (100%)
Manual shock		Yes: 31 (31%)
		No: 68 (68%)
Initial cardiac rhythm	VF	20 (20%)
	VT	3 (3%)
	Asystole	33 (33%)
	High degree AVB/ Bradycardia	2 (2%)
	PEA	41 (41%)
Hospitalization characteristics		
Alive and hospitalized		Yes: 51 (51%)
		No: 48 (49%)
Hospitalization ward	ICCU	25 (25%)
	General ICU	1 (1%)
	Internal medicine ward	25 (25%)
Targeted temperature management		11 (11%)

AED = automated external defibrillator, ALS = advanced life support, AVB = atrioventricular block, BLS = basic life support, CABG = coronary artery bypass grafting, CVA = cerebrovascular accident, ED = emergency department, EMS = emergency medical services, EMT = emergency medical technician, ICCU = intensive cardiac care unit, ICU = intensive care unit, MI = myocardial infarction, PCI = percutaneous coronary intervention, PEA = pulseless electrical activity, PVD = peripheral vascular disease, VF = ventricular fibrillation, and VT = ventricular tachycardia

vention was performed in 12 cases (12%). Among those cases, the culprit artery was identified as the left anterior descending artery in 7 cases (7%), the left circumflex artery in 3 cases (3%), and the right coronary artery in 2 cases (2%). Targeted temperature management was administered to 11 patients (11%).

PATIENT CHARACTERISTICS AND OUTCOMES

A comparison of the characteristics of patients who survived and were discharged with those who died during hospitalization following OHCA is detailed in Table 2. Several factors were associated with survival to discharge versus in-hospital death. Survivors were significantly younger (69.5 [IQR 67–77] vs. 79.1 [IQR 74–89], P = 0.001) with male sex predominance (80.8% vs. 54.2%, P = 0.017) [Table 2].

With regard to out-of-hospital characteristics, as expected, among survivals, the incidence of a shockable rhythm was significantly higher (54% vs. 12%, P < 0.001). Despite the use in small numbers, using an automated chest compression device was more common among non-survivors (12% vs. 44%, P = 0.005). Eighteen cases were classified as unwitnessed and 3 survived hospital discharge.

Hospitalization data showed a significantly higher rate of ST-elevation on electrocardiogram among survivors (28% vs. 16%, P = 0.03). In addition, survivors had higher mean pH levels (7.2 vs. 6.9, P < 0.001) and albumin levels (3.7 g/dl vs. 3.0 g/dl, P < 0.001) and significantly lower lactate levels (46.3 mg/dl vs. 86.9 mg/dl, P < 0.001) at admission.

A sub-analysis of the survivor group (n=26) is presented in Table 3. This analysis compared patients with a CPC score of 1 (n=13, favorable neurological outcome) to those with CPC scores of 2–5 (n=13, impaired neurological outcomes). Several significant differences were noted. Patients with a CPC 1 score were more likely to present with a shockable rhythm (70% vs. 30%, P = 0.115) and to have ventricular fibrillation (VF) as the first rhythm on the ALS monitor (75% vs. 23%, P = 0.009). In addition, PCI was significantly more common in the CPC 1 group (61% vs. 4%, P < 0.001).

CLINICAL OUTCOMES

In-hospital mortality was 74% (n=73). Among survivors, discharge destinations included rehabilitation centers (15 patients, 15%), homes (7 patients, 7%), and nursing facilities (4 patients, 4%). CPC scores of patients who survived discharge were as follows: 13 patients (13%) had a

Table 2. A sub-analysis of survived to discharge patients vs. in-hospital mortality

Demographics	Survived to discharge (n=26)	Dead in the hospital (n=73)	*P*-value
Median age, years (IQR)	69.5 (67–77)	79.1 (74–89)	0.001
Male, n (%)	21 (80.8%)	39 (54.2%)	0.017
Prior MI, n (%)	7 (26.9%)	19 (27.5%)	0.952
Hypertension, n (%)	15 (57.7%)	51 (73.9%)	0.126
Dyslipidemia, n (%)	16 (61.5%)	48 (69.6%)	0.457
Diabetes, n (%)	6 (24.0%)	35 (47.9%)	0.024
Out-of-hospital event characteristics			
Event location			0.239
Home	16 (61.5%)	52 (71%)	
Public building	1 (3.8%)	1 (1.4%)	
Street	4 (15%)	6 (8.2%)	
Medical facility	3 (12%)	13 (18%)	
Other	2 (7.7%)	1 (1.4%)	
Witnessed arrest	22 (88%)	58 (81%)	0.399
BLS	17 (65%)	54 (74%)	0.524
EMT fast responders	8 (33%)	35 (49%)	
AED	13 (52%)	27 (37%)	0.233
DC shock	12 (48%)	19 (26%)	0.041

Demographics	Survived to discharge (n=26)	Dead in the hospital (n=73)	*P*-value
Shockable rhythm	13 (54%)	9 (12%)	< 0.001
Automated compression	3 (13%)	31 (44%)	0.005
EMS arrival time, minutes (mean)	09:17	10:19	0.591
Hospitalization characteristics			
Survived ED	26 (100%)	25 (34%)	< 0.001
Ward in hospital (% of survived ED)			0.005
ICCU	18 (69%)	7 (9%)	
ICU	1 (3%)	–	
MI	7 (26%)	18 (25%)	
ST-elevation	10 (28%)	12 (16%)	0.03
Coronary angiography	16 (62%)	3 (4%)	< 0.001
pH (mean)	7.2	6.9	< 0.001
Lactate mg/dl (mean)	46.3	86.9	< 0.001
CPC score			
1	13 (50%)		
2	10 (38%)		
3	2 (7%)		
4	1 (4%)		

AED = automated external defibrillator, ALS = advanced life support, AVB = atrioventricular block, BLS = basic life support, CABG = coronary artery bypass graft, CPC = cerebral performance category, CVA = cerebrovascular accident, ED = emergency department, EMS = emergency medical services, ICCU = intensive cardiac care unit, ICU = intensive care unit, MI = myocardial infarction, PEA = pulseless electrical activity, VF = ventricular fibrillation, and VT = ventricular tachycardia

CPC score of 1, indicating good cerebral performance; 10 (10%) had a CPC score of 2, indicating moderate cerebral disability; and three patients (3%) had a CPC score of 3–4, indicating severe cerebral disability. Figure 1 depicts clinical outcomes according to the main initial cardiac rhythms (VT/VF, PEA, and asystole).

DISCUSSION

In this pilot retrospective registry, we presented the prehospital and in-hospital characteristics of patients experiencing OHCA. In our cohort, most patients suffering from OHCA were elderly, with a large majority of events occurring at home. The prognosis for these patients is generally poor. However, most who survived hospitalization were discharged with good neurological performance.

Although the study provides a micro-snapshot of a much broader public health concern and clinical challenge, the data presented in this report partially correlate with previous studies. However, our findings indicated a more favorable outcome. In a systematic review and meta-analysis of global survival rates among adult OHCA patients who received CPR, Yan et al. [4] reported a global survival rate to hospital discharge of 9% (95% confidence interval 8.2–9.4%) and a European survival rate to hospital discharge of 12% (95% confidence interval 10.5–13.0%) [4], considerably lower than the 26% observed in our cohort. Similarly, a study from Israel by Deri and co-authors [6] reported a survival to discharge rate of 8%. This discrepancy can be primarily explained by the fact that the referenced studies included all OHCA cases, including those declared dead on arrival. In contrast, our cohort focused exclusively on

Table 3. Sub-analysis of OHCA survivors with CPC 1 vs CPC 2–5

	CPC 1 (n=13)	CPC 2–5 (n=13)	*P*-value
Age, mean ± standard deviation in years	65 ± 14.7	74 ± 13.3	0.11
Male	12 (92%)	9 (69%)	0.322
First rhythm on ALS monitor (n=25)*	VF (9, 75%)	VF (3, 23%)	0.009
	VT (0)	VT (1, 8%)	
	Asystole (2, 17%)	Asystole (1, 8%)	
	PEA (1, 8%)	PEA (8, 61%)	
Shockable rhythm	9 (70%)	4 (30%)	0.115
EMS arrival time (mean, mm:ss)	09:00	09:30	0.809
Coronary angiography	10 (77%)	6 (46%)	0.107

*One patient without a formal record of cardiac rhythm
ALS = advanced life support, CPC = cerebral performance category, DC = direct current, EMS = emergency medical services, OHCA = out-of-hospital cardiac arrest, PCI = percutaneous coronary intervention, PEA = pulseless electrical activity, VF = ventricular fibrillation, VT = ventricular tachycardia

patients transferred and admitted to the emergency department. Our data are somewhat comparable to the data reported by von Vopelius-Feldt and colleagues [10], which showed that patients with OHCA transferred to high-volume PCI-capable centers in England had an unadjusted discharge rate of 24%. This finding is also consistent with other reports demonstrating in-hospital mortality of approximately 50–60% [11].

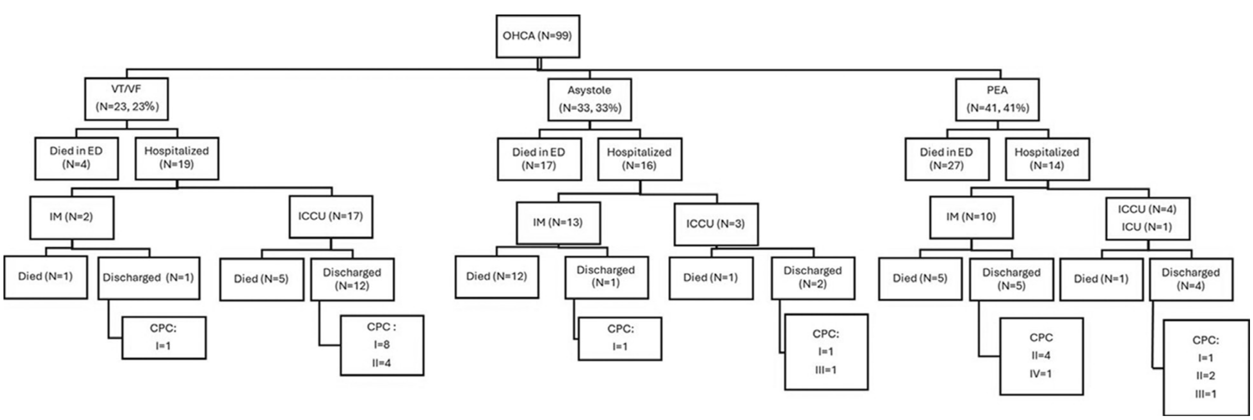
We identified several key factors significantly associated with survival and favorable neurological outcomes. Survivors were younger, predominantly male, and less likely to have diabetes mellitus. Out-of-hospital factors, such as the presence of a shockable rhythm and the use of direct current shock were also strongly predictive of survival, which is consistent with previous publications [1,2]. Furthermore, patients with a favorable neurological outcome (CPC 1) were significantly more likely to present with shockable rhythms. These findings are consistent with shockable rhythms shown in previous studies associated with favorable neurologic results after OHCA [12,13].

In-hospital PCI interventions were highly associated with survival and better neurological outcomes. In addition, survivors demonstrated better metabolic profiles, with higher admission pH and albumin levels and significantly lower lactate levels. Although EMS arrival time showed a trend toward being faster in the CPC 1 group, this difference was not statistically significant, likely due to the limited statistical power of the study and the small number of patients. Nevertheless, this trend suggests that faster EMS response may improve outcomes.

Notably, some factors in our geographic region of Israel favor better patient outcomes compared to other parts of the world. Paramedic-based EMS availability is exceptionally high, with trained volunteers often serving as the first responders on the scene, equipped with an AED. In addition, the urban area surrounding our medical center is unique in having six PCI-capable centers within a 20 km radius, ensuring a short transit of the patient.

Figure 1. Patient placement, survival, and neurological outcome by main initial cardiac rhythms

CPC= cerebral performance categories, ICU = intensive care unit, ICCU = intensive cardiac care unit, IM = internal medicine, OHCA = out-of-hospital cardiac arrest, PEA = pulseless electrical activity, ED = emergency department, VT = ventricular tachycardia, VF = ventricular fibrillation



Our study has several limitations. First, it is a retrospective observational and relatively small-scale analysis based on data from a single center, which may limit its generalizability. Furthermore, the composition of the survivor population in our study was subject to selection bias, as it reflected the preliminary clinical criteria for eligibility for ICCU admission. Another limitation of our study relates to the unique characteristics of the Israeli EMS system as mentioned. Second, the study was conducted in 2021, during the coronavirus disease 2019 (COVID-19) pandemic. While a rise in OHCA cases was noted globally in 2020 due to COVID-19 [14], less is known about its specific impact in 2021. Importantly, in our cohort, no cardiac arrests were directly attributed to severe COVID-19 infection. These limitations are common in similar studies. The abrupt and unpredictable nature of OHCA poses significant challenges for prospectively recruiting patients and systematically integrating their clinical data in a planned manner.

Our results underscore the necessity of a prospective, real time, national OHCA registry to gain powerful and clinically relevant insights that can influence patient care. An increasing number of OHCA registries have been established worldwide [15]. Some operate nationally, while others encompass broad geographical areas. These registries share common goals, including ongoing quality enhancement, epidemiological studies, and supporting the infrastructure for clinical research. [15-17]. OHCA registries can enable performance comparisons across various EMS systems, facilitating benchmarking, hypothesis generation, and further research by tracking OHCA incidence and outcome changes. As a result, they have become essential tools for OHCA management and research [18,19]. However, establishing and maintaining these registries involves significant challenges, including coordinating diverse service providers for data collection, ensuring sustainable funding, maintaining data quality, and safeguarding data security.

CONCLUSIONS

Most patients presenting with OHCA and surviving resuscitation after hospital admission are elderly, with most events occurring at home. Most of these cases carry grave prognosis. However, in those surviving hospitalizations, about half have good cerebral performance.

Correspondence

Prof. L. Fisher
Dept. of Medicine B, Sheba Medical Center, Tel Hashomer 52621, Israel
Phone: (972-3) 530-2435
Email: fisherlior1@gmail.com, lior.fisher@sheba.health.gov.il

References

1. Kiguchi T, Okubo M, Nishiyama C, et al. Out-of-hospital cardiac arrest across the World: First report from the International Liaison Committee on Resuscitation (ILCOR). *Resuscitation* 2020; 152: 39-49.
2. Kempster K, Howell S, Bernard S, et al. Out-of-hospital cardiac arrest outcomes in emergency departments. *Resuscitation* 2021; 166: 21-30.
3. Berdowski J, Berg RA, Tijssen JGP, Koster RW. Global incidences of out-of-hospital cardiac arrest and survival rates: Systematic review of 67 prospective studies. *Resuscitation* 2010; 81 (11): 1479-87.
4. Yan S, Gan Y, Jiang N, et al. The global survival rate among adult out-of-hospital cardiac arrest patients who received cardiopulmonary resuscitation: a systematic review and meta-analysis. *Crit Care* 2020; 24 (1): 61.
5. Myat A, Song KJ, Rea T. Out-of-hospital cardiac arrest: current concepts. *Lancet* 2018; 391 (10124): 970-9.
6. Deri Y, Berzon B, West D, et al. The impact of prehospital and hospital care on clinical outcomes in out-of-hospital cardiac arrest. *J Clin Med* 2022; 11 (22): 6851.
7. Merdler I, Sadeh B, Hochstadt A, et al. Automated external defibrillator use and outcomes after out-of-hospital cardiac arrest: an Israeli cohort study. *Coron Artery Dis* 2020; 31 (3): 289-92.
8. Ginsberg GM, Kark JD, Einav S. Cost-utility analysis of treating out of hospital cardiac arrests in Jerusalem. *Resuscitation* 2015; 86: 54-61.
9. Tabi M, Perel N, Taha L, et al. Out of hospital cardiac arrest - new insights and a call for a worldwide registry and guidelines. *BMC Emerg Med* 2024; 24 (1): 140.
10. von Vopelius-Feldt J, Perkins GD, Benger J. Association between admission to a cardiac arrest centre and survival to hospital discharge for adults following out-of-hospital cardiac arrest: A multi-centre observational study. *Resuscitation* 2021; 160: 118-25.
11. Amacher SA, Bohren C, Blatter R, et al. Long-term survival after out-of-hospital cardiac arrest: a systematic review and meta-analysis. *JAMA Cardiol* 2022; 7 (6): 633-43.
12. Sasson C, Rogers MAM, Dahl J, Kellermann AL. Predictors of survival from out-of-hospital cardiac arrest: a systematic review and meta-analysis. *Circ Cardiovasc Qual Outcomes* 2010; 3 (1): 63-81.
13. Rajan S, Folke F, Hansen SM, et al. Incidence and survival outcome according to heart rhythm during resuscitation attempt in out-of-hospital cardiac arrest patients with presumed cardiac etiology. *Resuscitation* 2017; 114: 157-63.
14. Baldi E, Sechi GM, Mare C, et al. COVID-19 kills at home: the close relationship between the epidemic and the increase of out-of-hospital cardiac arrests. *Eur Heart J* 2020; 41 (32): 3045-54.
15. Beck B, Bray JE, Smith K, et al; Aus-ROC Steering Committee. Description of the ambulance services participating in the Aus-ROC Australian and New Zealand out-of-hospital cardiac arrest Epistry. *Emerg Med Australas* 2016; 28 (6): 673-83.
16. Tjelmeland IBM, Alm-Kruse K, Grasner JT, et al. Importance of reporting survival as incidence: A cross-sectional comparative study on out-of-hospital cardiac arrest registry data from Germany and Norway. *BMJ Open* 2022; 12 (2): e058381.
17. Siddiqui FJ, McNally B, Gräsner JT, *et al.* Towards advancing Out-of-Hospital cardiac arrest (OHCA) registries globally: Considerations from the global OHCA registry (GOHCAR) collaborative. *Resusc Plus* 2024; 18: 100615.
18. McNally B. The importance of cardiac arrest registries *Scand J Trauma Resusc Emerg Med2014*; 22 (Suppl 1): A3.
19. Paratz ED, Rowsell L, Zentner D, et al; Australian UCDP Registry. Cardiac arrest and sudden cardiac death registries: a systematic review of global coverage. *Open Heart* 2020; 7 (1): e001195.