**This week's PubMed 25th June – 29th July 2023: articles of interest n = 194**

**CPR AND COVID-19**

**1.** Acute Med Surg. 2023 Jun 25;10(1):e00865. doi: 10.1002/ams2.865. eCollection 2023 Jan-Dec.
**Impact of the coronavirus disease 2019 (COVID-19) pandemic on the operational efficiency of emergency medical services and its association with out-of-hospital cardiac arrest survival rates: A population-based cohort study in Kobe, Japan.**
Sugiyama J(1)(2), Inoue S(1), Inada M(1), Miyazaki Y(1), Nakanishi N(1), Fujinami Y(3), Saito M(1), Ono Y(1), Toyama K(1), Toda F(2), Shirotsuki T(2), Shiotani S(2), Kotani J(1).
**ABSTRACT**
AIM: To identify whether the coronavirus disease 2019 (COVID-19) pandemic affects the operational efficiency of emergency medical services (EMS) and the survival rate of out-of-hospital cardiac arrest (OHCA) in prehospital settings. METHODS: We conducted a population-based cohort study in Kobe, Japan, between March 1, 2020, and September 31, 2022. In study 1, the operational efficiency of EMS, such as the total out-of-service time for ambulances, the daily occupancy rate of EMS, and response time, was compared between the pandemic and nonpandemic periods. In study 2, the impacts of the changes in EMS operational efficiency were investigated among patients with OHCA, with 1-month survival as the primary outcome and return of spontaneous circulation, 24-h survival, 1-week survival, and favorable neurological outcomes as the secondary outcomes. Logistic regression analysis was conducted to identify the factors associated with survival among patients with OHCA. RESULTS: The total out-of-service time, occupancy rate, and response time significantly increased during the pandemic period ($p < 0.001$). The response time during the pandemic period increased significantly per pandemic wave. Regarding OHCA outcomes, 1-month survival rates during the pandemic period significantly decreased compared with those during the nonpandemic period (pandemic 3.7% vs. nonpandemic 5.7%; $p < 0.01$). Similarly, 24-h survival (9.9% vs. 12.8%), and favorable neurological outcomes significantly decreased during the pandemic period. In the logistic regression analysis, response time was associated with lower OHCA survival in all outcomes ($p < 0.05$). CONCLUSION: The COVID-19 pandemic has been associated with reduced operational efficiency of EMS and decreased OHCA survival rates. Further research is required to improve the efficiency of EMS and OHCA survival rates.

**2.** Prehosp Emerg Care. 2023 Jul 26:1-8. doi: 10.1080/10903127.2023.2241893. Online ahead of print.
**COVID-19 Testing Among Out-of-Hospital Cardiac Arrest Patients: Implications for Public Health.**
Stone RM(1)(2), Kaufman B(1), Burns TA(1), Delbridge TR(3).
**ABSTRACT**
Objective: To compare COVID-19 test positivity among out-of-hospital cardiac arrest patients whose resuscitative efforts were terminated in the field with the surrounding community.Methods: This was a retrospective cohort study of out-of-hospital cardiac arrest patients for whom unsuccessful resuscitative efforts were terminated in the field. Emergency medical services (EMS) personnel obtained post-mortem COVID-19 nasal swab specimens from these patients between July 1, 2020 and February 28, 2022 to facilitate patient contact tracing and awareness of potential occupational exposure. A chi-square (n-1) was used to compare test result proportions between cardiac arrest patients and the community at large. A Pearson correlation was used to correlate test positivity among the two groups.Results: EMS personnel obtained post-mortem specimens from 648 cardiac arrest patients; 20 (3.1%) were inconclusive, 69 (10.6%) were positive, and 559 (86.2%) were negative. Monthly positivity ranged from 0.0% to 34.0%. For the community at large, overall test

positivity during the same period was 5.1%, with a monthly range from 0.4% to 15.2%. Overall, expired and tested cardiac arrest patients had 5.9% (95% CI 3.68% - 8.59%) greater COVID-19 test positivity than the general community. There was significant correlation in monthly positivity rates between the groups ($r = 0.778$, $p < 0.001$, 95% CI 0.51 - 0.91). Conclusions: Compared to the general population, COVID-19 was over-represented among EMS cardiac arrest patients who died in the field. Post-mortem testing by EMS personnel, not typical practice, identified infectious disease cases that would have otherwise gone undetected, indicating potential for future surveillance applications.

## CPR/MECHANICAL CHEST COMPRESSION

**1.** J Clin Med. 2023 Jun 30;12(13):4429. doi: 10.3390/jcm12134429.
**Use of Mechanical Chest Compression for Resuscitation in Out-Of-Hospital Cardiac Arrest-Device Matters: A Propensity-Score-Based Match Analysis.**
Primi R(1)(2), Bendotti S(1), Currao A(1), Sechi GM(3), Marconi G(3), Pamploni G(4), Panni G(5), Sgotti D(5), Zorzi E(6), Cazzaniga M(6), Piccolo U(6), Bussi D(7), Ruggeri S(7), Facchin F(8), Soffiato E(8), Ronchi V(9), Contri E(4), Centineo P(10), Reali F(11), Sfolcini L(12), Gentile FR(1)(12), Baldi E(1), Compagnoni S(1)(12), Quilico F(1)(12), Vicini Scajola L(1)(12), Lopiano C(1)(12), Fasolino A(1)(12), Savastano S(1), All The Lombardia CARe Researchers.
**ABSTRACT**
BACKGROUND: Devices for mechanical cardiopulmonary resuscitation (CPR) are recommended when high quality CPR cannot be provided. Different devices are available, but the literature is poor in direct comparison studies. Our aim was to assess whether the type of mechanical chest compressor could affect the probability of return of spontaneous circulation (ROSC) and 30-day survival in Out-of-Hospital Cardiac Arrest (OHCA) patients as compared to manual standard CPR. METHODS: We considered all OHCAs that occurred from 1 January 2015 to 31 December 2022 in seven provinces of the Lombardy region equipped with three different types of mechanical compressor: Autopulse®(ZOLL Medical, MA), LUCAS® (Stryker, MI), and Easy Pulse® (Schiller, Switzerland). RESULTS: Two groups, 2146 patients each (manual and mechanical CPR), were identified by propensity-score-based random matching. The rates of ROSC (15% vs. 23%, $p < 0.001$) and 30-day survival (6% vs. 14%, $p < 0.001$) were lower in the mechanical CPR group. After correction for confounders, Autopulse® [OR 2.1, 95%CI (1.6-2.8), $p < 0.001$] and LUCAS® [OR 2.5, 95%CI (1.7-3.6), $p < 0.001$] significantly increased the probability of ROSC, and Autopulse® significantly increased the probability of 30-day survival compared to manual CPR [HR 0.9, 95%CI (0.8-0.9), $p = 0.005$]. CONCLUSION: Mechanical chest compressors could increase the rate of ROSC, especially in case of prolonged resuscitation. The devices were dissimilar, and their different performances could significantly influence patient outcomes. The load-distributing-band device was the only mechanical chest able to favorably affect 30-day survival.

**2.** PLoS One. 2023 Jul 26;18(7):e0288688. doi: 10.1371/journal.pone.0288688. eCollection 2023.
**Development of an automatic device performing chest compression and external defibrillation: An animal-based pilot study.**
Roh YI(1), Jung WJ(1), Im HY(1), Lee Y(1), Im D(1), Cha KC(1), Hwang SO(1).
**ABSTRACT**
BACKGROUND: Automatic chest compression devices (ACCDs) can promote high-quality cardio-pulmonary resuscitation (CPR) and are widely used worldwide. Early application of automated external defibrillators (AEDs) along with high-quality CPR is crucial for favorable outcomes in patients with cardiac arrest. Here, we developed an automated CPR (A-CPR) apparatus that

combines ACCD and AED and evaluated its performance in a pilot animal-based study. METHODS: Eleven pigs (n = 5, A-CPR group; n = 6, ACCD CPR and AED [conventional CPR (C-CPR)] group) were enrolled in this study. After 2 min observation without any treatment following ventricular fibrillation induction, CPR with a 30:2 compression/ventilation ratio was performed for 6 min, mimicking basic life support (BLS). A-CPR or C-CPR was applied immediately after BLS, and resuscitation including chest compression and defibrillation, was performed following a voice prompt from the A-CPR device or AED. Hemodynamic parameters, including aortic pressure, right atrial pressure, coronary perfusion pressure, carotid blood flow, and end-tidal carbon dioxide, were monitored during resuscitation. Time variables, including time to start rhythm analysis, time to charge, time to defibrillate, and time to subsequent chest compression, were also measured. RESULTS: There were no differences in baseline characteristics, except for arterial carbon dioxide pressure (39 in A-CPR vs. 33 in C-CPR, p = 0.034), between the two groups. There were no differences in hemodynamic parameters between the groups. However, time to charge (28.9 ± 5.6 s, A-CPR group; 47.2 ± 12.4 s, C-CPR group), time to defibrillate (29.1 ± 7.2 s, A-CPR group; 50.5 ± 12.3 s, C-CPR group), and time to subsequent chest compression (32.4 ± 6.3 s, A-CPR group; 56.3 ± 10.7 s, C-CPR group) were shorter in the A-CPR group than in the C-CPR group (p = 0.015, 0.034 and 0.02 respectively). CONCLUSIONS: A-CPR can provide effective chest compressions and defibrillation, thereby shortening the time required for defibrillation.

## REGISTRIES, REVIEWS AND EDITORIALS

**1.** Resuscitation. 2023 Aug;189:109888. doi: 10.1016/j.resuscitation.2023.109888. Epub 2023 Jun 26.
**Out-of-hospital cardiac arrests occurring at school in France: A nation-wide retrospective cohort study from the RéAC registry.**
Lafrance M(1), Canon V(2), Hubert H(2), Grunau B(3), Javaudin F(4), Recher M(5), Heidet M(6); GR-RéAC(7); members of the SFMU cardiac arrest board.

**ABSTRACT**
AIM: We sought to describe the characteristics of at-school out-of-hospital cardiac arrests cases, subsequent basic life support, as well as ultimate patient outcomes. METHODS: This was a nation-wide, multicentre, retrospective cohort study from the French national population-based RéAC out-of-hospital cardiac arrest registry (July 2011 - March 2023). We compared the characteristics and outcomes of cases occurring at schools vs. in other public places. RESULTS: Of the 149,088 national out-of-hospital cardiac arrests, 25,071 were public: 86 (0.3%) and 24,985 (99.7%) in schools and other public places, respectively. At-school out-of-hospital cardiac arrests, in comparison to other public places, were: significantly younger (median: 42.5 vs. 58 years, p < 0.001); more commonly of a medical cause (90.7% vs. 63.8%, p < 0.001), more commonly bystander-witnessed (93.0% vs. 73.4%, p < 0.001) and recipients of bystander cardiopulmonary resuscitation (78.8% vs. 60.6%, p = 0.001) with shorter median no-flow durations (2 min. vs. 7 min.); with greater bystander automated external defibrillator application (38.9% vs. 18.4%) and defibrillation (23.6%, vs. 7.9%; all p < 0.001). At-school patients had greater rates of return of spontaneous circulation than out-of-school ones (47.7%, vs. 31.8%; p = 0.002), higher rates of survival at arrival at hospital (60.5% vs. 30.7%; p < 0.001) and at 30-days (34.9% vs. 11.6%; p < 0.001), and survival with favourable neurological outcomes at 30 days (25.9% vs. 9.2%; p < 0.001). CONCLUSION: At-school out-of-hospital cardiac arrests were rare in France, however demonstrated favourable prognostic features and outcomes. The use of automated external defibrillators in at-school cases, while more common than cases occurring elsewhere, should be improved.

**2.** J Clin Med. 2023 Jun 18;12(12):4118. doi: 10.3390/jcm12124118.

**General Critical Care, Temperature Control, and End-of-Life Decision Making in Patients Resuscitated from Cardiac Arrest.**

Chalkias A(1)(2), Adamos G(3), Mentzelopoulos SD(3).

**ABSTRACT**

Cardiac arrest affects millions of people per year worldwide. Although advances in cardiopulmonary resuscitation and intensive care have improved outcomes over time, neurologic impairment and multiple organ dysfunction continue to be associated with a high mortality rate. The patho-physiologic mechanisms underlying the post-resuscitation disease are complex, and a coordinated, evidence-based approach to post-resuscitation care has significant potential to improve survival. Critical care management of patients resuscitated from cardiac arrest focuses on the identification and treatment of the underlying cause(s), hemodynamic and respiratory support, organ protection, and active temperature control. This review provides a state-of-the-art appraisal of critical care management of the post-cardiac arrest patient.

**3.** Resuscitation. 2023 Jul;188:109819. doi: 10.1016/j.resuscitation.2023.109819. Epub 2023 May 5.

**Does speed kill? Post-ROSC prehospital scene time and outcomes.**

Alangaden KJ(1), Mosesso VN(2).

**NO ABSTRACT AVAILABLE**

**4.** Resuscitation. 2023 Jul;188:109753. doi: 10.1016/j.resuscitation.2023.109753. Epub 2023 Feb 25.

**The association of the post-resuscitation on-scene interval and patient outcomes after out-of-hospital cardiac arrest.**

Khan L(1), Hutton J(2), Yap J(1), Dodek P(3), Scheuermeyer F(4), Asamoah-Boaheng M(5), Heidet M(6), Wall N(7), Fordyce CB(8), van Diepen S(9), Christenson J(4), Grunau B(10).

**ABSTRACT**

BACKGROUND: After resuscitation from out-of-hospital cardiac arrest (OHCA) by Emergency Medical Services (EMS), the amount of time that should be dedicated to pre-transport stabilization is unclear. We examined whether the time spent on-scene after return of spontaneous circulation (ROSC) was associated with patient outcomes. METHODS: We examined consecutive adult EMS-treated OHCAs from the British Columbia Cardiac Arrest registry (January 1/2019-June 1/2021) that had on-scene ROSC (sustained to scene departure). The primary outcome was favourable neurological outcome (Cerebral Performance Category ≤ 2) at hospital discharge; secondary outcomes were re-arrest during transport and hospital-discharge survival. Using adjusted logistic regression models, we estimated the association between the post-resuscitation on-scene interval (divided into quartiles) and outcomes. RESULTS: Of 1653 cases, 611 (37%) survived to hospital discharge, and 523 (32%) had favourable neurological outcomes. The median post-resuscitation on-scene interval was 18.8 minutes (IQR:13.0-25.5). Compared to the first post-resuscitation on-scene interval quartile, neither the second (adjusted odds ratio [AOR] 1.19; 95% CI 0.72-1.98), third (AOR 1.10; 95% CI 0.67-1.81), nor fourth (AOR 1.54; 95% CI 0.93-2.56) quartiles were associated with favourable neurological outcomes; however, the fourth quartile was associated with a greater odds of hospital-discharge survival (AOR 1.73; 95% CI 1.05-2.85), and both the third (AOR 0.40; 95% CI 0.22-0.72) and fourth (AOR 0.44;95% CI 0.24-0.81) quartiles were associated with a lower odds of intra-transport re-arrest. CONCLUSION: Among resuscitated OHCAs, increased post-resuscitation on-scene time was not associated with improved neurological outcomes, but was associated with improved survival to hospital discharge and decreased intra-transport re-arrest.

**5.** Emerg Med Clin North Am. 2023 Aug;41(3):xv-xvi. doi: 10.1016/j.emc.2023.05.004. Epub 2023 Jun 2.

**Current Management of the Cardiac Arrest Patient.**
Singh A(1), Brady W(2).
**NO ABSTRACT AVAILABLE**

**6.** Resusc Plus. 2023 Jun 16;15:100414. doi: 10.1016/j.resplu.2023.100414. eCollection 2023 Sep.
**Data-driven sudden cardiac arrest research in Europe: Experts' perspectives on ethical challenges and governance strategies.**
Bak MAR(1), Vroonland JCH(2), Blom MT(3)(4)(5), Damjanovic D(6), Willems DL(1), Tan HL(3)(7), Corrette Ploem M(1).
**ABSTRACT**
BACKGROUND: Observational studies using large-scale databases and biobanks help improve prevention and treatment of sudden cardiac arrest (SCA) but the lack of guidance on data protection issues in this setting may harm patients' rights and the research enterprise itself. This qualitative study explored the ethical aspects of observational SCA research, as well as solutions. METHODS: European experts in SCA research, medical ethics and health law reflected on this topic through semi-structured interviews (N = 29) and a virtual roundtable conference (N = 18). The ESCAPE-NET project served as a discussion case. Findings were coded and thematically analysed. RESULTS: The first theme concerned the potential benefits and harms (at individual and group level) of observational data-based SCA studies and included the following sub-themes: societal value, scientific validity, data privacy, disclosure of genetic findings, stigma and discrimination, and medicalisation of sudden death. The second theme involved governance through 'privacy by design', 'privacy by policy' and associated regulation and oversight. Sub-themes were: de-identification of data, informed consent (broad and deferred), ethics review, and harmonisation. CONCLUSIONS: Researchers and scientific societies should be aware that ethico-legal issues may arise during data-driven studies in SCA and other emergencies. These can be mitigated by combining technical data protection safeguards with appropriate informed consent policies and proportional ethics oversight. To ensure responsible conduct of data research in emergency medicine, we recommend the establishment of 'codes of conduct' which should be developed in interdisciplinary groups and together with patient representatives.

**7.** Heart Lung Circ. 2023 Jul 5:S1443-9506(23)03629-6. doi: 10.1016/j.hlc.2023.06.573. Online ahead of print.
**The New South Wales Sudden Cardiac Arrest Registry: A Data Linkage Cohort Study.**
Leslie F(1), Avis SR(2), Bagnall RD(3), Bendall J(4), Briffa T(5), Brouwer I(6), Butters A(7), Figtree GA(8), La Gerche A(9), Gray B(10), Nedkoff L(11), Page G(12), Paratz E(9), Semsarian C(13), Sy RW(10), du Toit-Prinsloo L(6), Yeates L(14), Sweeting J(1), Ingles J(15).
**ABSTRACT**
BACKGROUND: Sudden cardiac arrest (SCA) in young people aged 1 to 50 years often occurs with no presenting symptoms or risk factors prompting screening for cardiovascular disease prior to their cardiac arrest. Approximately 3,000 young Australians suffer from sudden cardiac death (SCD) each year, making this a major public health issue. However, there is significant variation in the way incidence is estimated resulting in discrepancy across reporting which impacts our ability to understand and prevent these devastating events. We describe the New South Wales (NSW) Sudden Cardiac Arrest Registry: a retrospective, data linkage study which will identify all SCAs in the young in NSW from 2009 through to June 2022. OBJECTIVE: To determine the incidence, demographic characteristics and causes of SCA in young people. We will develop an NSW-based registry that will contribute to a greater understanding of SCA including risk factors and outcomes. METHODS: The cohort will include all people who experience a SCA in the NSW community aged between 1 to 50

years. Cases will be identified using the following three datasets: the Out of Hospital Cardiac Arrest Register housed at NSW Ambulance, the NSW Emergency Department Data Collection, and the National Coronial Information System. Data from eight datasets will be collected, anonymised and linked for the entire cohort. Analysis will be undertaken and reported using descriptive statistics. CONCLUSIONS: The NSW SCA registry will be an important resource for the improved understanding of SCA and inform the widespread impacts it has on individuals, their families and society.

**8.** Resuscitation. 2023 Aug;189:109900. doi: 10.1016/j.resuscitation.2023.109900. Epub 2023 Jul 5.
**Value of EEG in outcome prediction of hypoxic-ischemic brain injury in the ICU: A narrative review.**
Hoedemaekers C(1), Hofmeijer J(2), Horn J(3).

**ABSTRACT**

Prognostication of comatose patients after cardiac arrest aims to identify patients with a large probability of favourable or unfavouble outcome, usually within the first week after the event. Electroencephalography (EEG) is a technique that is increasingly used for this purpose and has many advantages, such as its non-invasive nature and the possibility to monitor the evolution of brain function over time. At the same time, use of EEG in a critical care environment faces a number of challenges. This narrative review describes the current role and future applications of EEG for outcome prediction of comatose patients with postanoxic encephalopathy.

**9.** Eur Heart J. 2023 Jul 6:ehad358. doi: 10.1093/eurheartj/ehad358. Online ahead of print.
**Outcomes of out-of-hospital cardiac arrest in adult congenital heart disease: a Danish nationwide study.**
Barcella CA(1)(2), Christensen DM(3), Idorn L(4), Mudalige N(5), Malmborg M(1), Folke F(1)(6)(7), Torp-Pedersen C(8)(9), Gislason G(1)(3), El-Chouli M(3).

**ABSTRACT**

AIMS: The risk, characteristics, and outcome of out-of-hospital cardiac arrest (OHCA) in patients with congenital heart disease (CHD) remain scarcely investigated. METHODS AND RESULTS: An epidemiological registry-based study was conducted. Using time-dependent Cox regression models fitted with a nested case-control design, hazard ratios (HRs) with 95% confidence intervals of OHCA of presumed cardiac cause (2001-19) associated with simple, moderate, and severe CHD were calculated. Moreover, using multiple logistic regression, we investigated the association between pre-hospital OHCA characteristics and 30-day survival and compared 30-day survival in OHCA patients with and without CHD. Overall, 43 967 cases (105 with simple, 144 with moderate, and 53 with severe CHD) and 219 772 controls (median age 72 years, 68.2% male) were identified. Any type of CHD was found to be associated with higher rates of OHCA compared with the background population [simple CHD: HR 1.37 (1.08-1.70); moderate CHD: HR 1.64 (1.36-1.99); and severe CHD: HR 4.36 (3.01-6.30)]. Pre-hospital cardiopulmonary resuscitation and defibrillation were both associated with improved 30-day survival in patients with CHD, regardless of CHD severity. Among patients with OHCA, simple, moderate, and severe CHD had a similar likelihood of 30-day survival compared with no CHD [odds ratio 0.95 (0.53-1.69), 0.70 (0.43-1.14), and 0.68 (0.33-1.57), respectively]. CONCLUSION: A higher risk of OHCA was found throughout the spectrum of CHD. Patients with and without CHD showed the same 30-day survival, which relies on the pre-hospital chain of survival, namely cardiopulmonary resuscitation and defibrillation.

**10.** Eur Heart J. 2023 Jul 6:ehad416. doi: 10.1093/eurheartj/ehad416. Online ahead of print.
**Sudden cardiac arrest in adult congenital heart disease: a challenge to be tackled.**
Waldmann V(1)(2), Narayanan K(2)(3), Marijon E(1)(2).

**NO ABSTRACT AVAILABLE**

**11.** Prehosp Emerg Care. 2023 Jul 18:1-13. doi: 10.1080/10903127.2023.2231559. Online ahead of print.

**Community Interventions for Out-of-Hospital Cardiac Arrest in Resource-Limited Settings: A Scoping Review Across Low, Middle, and High-Income Countries.**

Grubic N(1), Hill B(1), Allan KS(2), Dainty KN(3)(4), Johri AM(1), Brooks SC(5).

**ABSTRACT**

BACKGROUND: Out-of-hospital cardiac arrest (OHCA) is a major global health challenge, characterized by poor survival outcomes worldwide. Resource-limited settings are burdened with suboptimal emergency response and worse outcomes than high-resource areas. Engaging the community in the response to OHCA has the potential to improve outcomes, although an overview of community interventions in resource-limited settings has not been provided. OBJECTIVE: This review evaluated the scope of community-based OHCA interventions in resource-limited settings. METHODS: Literature searches in electronic databases (MEDLINE, EMBASE, Global Health, CINAHL, Cochrane Central Register of Controlled Clinical Trials) and grey literature sources were performed. Abstract screening, full-text review, and data extraction of eligible studies were conducted independently by two reviewers. The PCC (Population, Concept, and Context) framework was used to assess study eligibility. Studies that evaluated community-based interventions for laypeople (Population), targeting emergency response activation, cardiopulmonary resuscitation (CPR), or automated external defibrillator (AED) use (Concept) in resource-limited settings (Context) were included. Resource-limited settings were identified by financial pressures (low-income or lower-middle-income country, according to World Bank data on year of publication) or geographical factors (setting described using keywords indicative of geographical remoteness in upper-middle-income or high-income country). RESULTS: Among 14,810 records identified from literature searches, 60 studies from 28 unique countries were included in this review. Studies were conducted in high-income (n = 35), upper-middle-income (n = 2), lower-middle-income (n = 22), and low-income countries (n = 1). Community interventions included bystander CPR and/or AED training (n = 34), community responder programs (n = 8), drone-delivered AED networks (n = 6), dispatcher-assisted CPR programs (n = 4), regional resuscitation campaigns (n = 3), public access defibrillation programs (n = 3), and crowdsourcing technologies (n = 2). CPR and/or AED training were the only interventions evaluated in low-income, lower-middle-income, and upper-middle-income countries. CONCLUSIONS: Interventions aimed at improving the community response to OHCA in resource-limited settings differ globally. There is a lack of reported studies from low-income countries and certain continental regions, including South America, Africa, and Oceania. Evaluation of interventions other than CPR and/or AED training in low- and middle-income countries is needed to guide community emergency planning and health policies.

**12.** JAMA Netw Open. 2023 Jul 3;6(7):e2321783. doi: 10.1001/jamanetworkopen.2023.21783.

**Sex- and Age-Based Disparities in Public Access Defibrillation, Bystander Cardiopulmonary Resuscitation, and Neurological Outcome in Cardiac Arrest.**

Ishii M(1), Tsujita K(1), Seki T(2), Okada M(2), Kubota K(2)(3), Matsushita K(1), Kaikita K(4), Yonemoto N(5), Tahara Y(5), Ikeda T(5); Japanese Circulation Society with Resuscitation Science Study (JCS-ReSS) Investigators.

**ABSTRACT**

IMPORTANCE: Younger females with out-of-hospital cardiac arrest (OHCA) in public locations have less likelihood to receive public access defibrillation and bystander cardiopulmonary resuscitation (CPR). However, the association between age- and sex-based disparities and neurological outcomes remains underexamined. OBJECTIVE: To investigate the association between sex and age and the

rate of receiving bystander CPR, automated external defibrillator defibrillation, and neurological outcomes in patients with OHCA. DESIGN, SETTING, AND PARTICIPANTS: This cohort study used the All-Japan Utstein Registry, a prospective, population-based, nationwide database in Japan containing data on 1 930 273 patients with OHCA between January 1, 2005, and December 31, 2020. The cohort comprised patients with OHCA of cardiac origin that was witnessed by citizens and treated by emergency medical service personnel. The data were analyzed from September 3, 2022, to May 5, 2023. EXPOSURE: Sex and age. MAIN OUTCOMES AND MEASURES: The primary outcome was favorable neurological outcome at 30 days after an OHCA. Favorable neurological outcome was defined as a Cerebral Performance Category score of 1 (indicating good cerebral performance) or 2 (indicating moderate cerebral disability). The secondary outcomes were the rates of receiving public access defibrillation and bystander CPR. RESULTS: The 354 409 included patients who experienced bystander-witnessed OHCA of cardiac origin had a median (IQR) age of 78 (67-86) years and 136 520 were females (38.5%). The rate of receiving public access defibrillation was higher in males than females (3.2% vs 1.5%; P < .001). Stratified by age, age- and sex-based disparities in prehospital lifesaving interventions by bystanders and in neurological outcomes were observed. Although younger females had a lower rate of receiving public access defibrillation and bystander CPR than males, younger females had a higher favorable neurological outcome compared with males of the same age (odds ratio [OR], 1.19; 95% CI, 1.08-1.31). In younger females with OHCA that was witnessed by nonfamily bystanders, receiving public access defibrillation (OR, 3.51; 95% CI, 2.34-5.27) or bystander CPR (OR, 1.62; 95% CI, 1.20-2.22) was associated with a favorable neurological outcome. CONCLUSIONS AND RELEVANCE: Results of this study suggest a pattern of significant sex- and age-based differences in bystander CPR, public access defibrillation, and neurological outcomes in Japan. Improvement in neurological outcomes in patients with OHCA, especially younger females, was associated with increased use of public access defibrillation and bystander CPR.

**13.** J Cardiol. 2023 Aug;82(2):162. doi: 10.1016/j.jjcc.2023.04.002. Epub 2023 Apr 6.
**Prediction of clinical outcomes following return of spontaneous circulation.**
Fujii M(1), Nakamura M(1), Imamura T(2).
**NO ABSTRACT AVAILABLE**

**14.** JAMA Netw Open. 2023 Jul 3;6(7):e2321751. doi: 10.1001/jamanetworkopen.2023.21751.
**Dissecting the Complex Association Between Age and Sex in Cardiac Arrest Outcomes-Age Disparity, Sex Disparity, or All of the Above?**
Perman SM(1), Beekman R(2).
**NO ABSTRACT AVAILABLE**

**15.** Emerg Med Clin North Am. 2023 Aug;41(3):509-528. doi: 10.1016/j.emc.2023.03.005. Epub 2023 Apr 14.
**Cardiopulmonary Resuscitation: The Importance of the Basics.**
Long B(1), Gottlieb M(2).
**ABSTRACT**
Cardiac arrest is the loss of organized cardiac activity. Unfortunately, survival to hospital discharge is poor, despite recent scientific advances. The goals of cardiopulmonary resuscitation (CPR) are to restore circulation and identify and correct an underlying etiology. High-quality compressions remain the foundation of CPR, optimizing coronary and cerebral perfusion pressure. High-quality compressions must be performed at the appropriate rate and depth. Interruptions in compressions are detrimental to management. Mechanical compression devices are not associated with improved outcomes but can assist in several situations.

**16.** Resuscitation. 2023 Jul 13:109906. doi: 10.1016/j.resuscitation.2023.109906. Online ahead of print.

**The Effect of Recognition on Survival after Out-of-Hospital Cardiac Arrest and Implications for Biosensor Technologies.**

Hutton J(1), Grunau B(2), Asamoah-Boaheng M(3), Christenson J(3), Khalili M(4), Kuo C(5), Lingawi S(6), Puyat JH(7), Shadgan B(8), Sobolev B(9).

**ABSTRACT**

BACKGROUND: Biosensor technologies have been proposed as a solution to provide recognition and facilitate earlier responses to unwitnessed out-of-hospital cardiac arrest (OHCA) cases. We sought to estimate the effect of recognition on survival and modelled the potential incremental impact of increased recognition of unwitnessed cases on survival to hospital discharge, to demonstrate the potential benefit of biosensor technologies. METHODS: We included cases from the British Columbia Cardiac Arrest Registry (2019-2020), which includes Emergency Medical Services (EMS)-assessed OHCAs. We excluded cases that would not have benefitted from early recognition (EMS-witnessed, terminal illness, or do-not-resuscitate). Using a mediation analysis, we estimated the relative benefits on survival of a witness recognizing vs. intervening in an OHCA; and estimated the expected additional number of survivors resulting from increasing recognition alone using a bootstrap logistic regression framework. RESULTS: Of 13,655 EMS-assessed cases, 11,412 were included (6314 EMS-treated, 5098 EMS-untreated). Survival to hospital discharge was 191/8879 (2.2%) in unwitnessed cases and 429/2533 (17%) in bystander-witnessed cases. Of the total effect attributable to a bystander witness, recognition accounted for 84% (95% CI: 72, 86) of the benefit. If all previously unwitnessed cases had been bystander witnessed, we would expect 1198 additional survivors. If these cases had been recognized, but no interventions performed, we would expect 912 additional survivors. CONCLUSION: Unwitnessed OHCA account for the majority of OHCAs, yet survival is dismal. Methods to improve recognition, such as with biosensor technologies, may lead to substantial improvements in overall survival.

**17.** J Am Coll Cardiol. 2023 Jul 18;82(3):211-213. doi: 10.1016/j.jacc.2023.05.018.

**Community Volunteer Responder Programs in Cardiac Arrest: The Horse Has Bolted, It's Time to Optimize.**

Bray JE(1), Smith CM(2), Nehme Z(3).

**NO ABSTRACT AVAILABLE**

**18.** Resusc Plus. 2023 Jun 21;15:100416. doi: 10.1016/j.resplu.2023.100416. eCollection 2023 Sep.

**Resuscitation Plus Special Issue: Cardiac arrest research.**

Couper K(1)(2), Masterson S(3), Nehme Z(4)(5)(6).

**NO ABSTRACT AVAILABLE**

**19.** Wilderness Environ Med. 2023 Jul 18:S1080-6032(23)00108-4. doi: 10.1016/j.wem. 2023.06.002. Online ahead of print.

**How Can We Improve Survival from Out-of-Hospital Cardiac Arrest?**

Windsor JS(1).

**NO ABSTRACT AVAILABLE**

**20.** Emerg Med Australas. 2023 Aug;35(4):706. doi: 10.1111/1742-6723.14215. Epub 2023 Apr 13.

**Re: Outcomes in traumatic cardiac arrest patients who underwent advanced life support.**

Parvaresh-Masoud M(1).

**NO ABSTRACT AVAILABLE**

**21.** JACC Clin Electrophysiol. 2023 Jun 17:S2405-500X(23)00340-7. doi: 10.1016/j.jacep.2023.05.026. Online ahead of print.
**Winter Peaks in In-Hospital Cardiac Arrest: Patient Susceptibility or Hospital Overcrowding?**
Do DH(1).
**NO ABSTRACT AVAILABLE**

**22.** Biomed Pharmacother. 2023 Jul 20;165:115201. doi: 10.1016/j.biopha.2023.115201. Online ahead of print.
**Harnessing the therapeutic potential of mesenchymal stem cell-derived exosomes in cardiac arrest: Current advances and future perspectives.**
Li K(1), Zhu Z(2), Sun X(3), Zhao L(4), Liu Z(5), Xing J(6).
**ABSTRACT**
BACKGROUND: Cardiac arrest (CA), characterized by sudden onset and high mortality rates, is one of the leading causes of death globally, with a survival rate of approximately 6-24%. Studies suggest that the restoration of spontaneous circulation (ROSC) hardly improved the mortality rate and prognosis of patients diagnosed with CA, largely due to ischemia-reperfusion injury. MAIN BODY: Mesenchymal stem cells (MSCs) exhibit self-renewal and strong potential for multilineage differentiation. Their effects are largely mediated by extracellular vesicles (EVs). Exosomes are the most extensively studied subgroup of EVs. EVs mainly mediate intercellular communication by transferring vesicular proteins, lipids, nucleic acids, and other substances to regulate multiple processes, such as cytokine production, cell proliferation, apoptosis, and metabolism. Thus, exosomes exhibit significant potential for therapeutic application in wound repair, tissue reconstruction, inflammatory reaction, and ischemic diseases. CONCLUSION: Based on similar pathological mechanisms underlying post-cardiac arrest syndrome involving various tissues and organs in many diseases, the review summarizes the therapeutic effects of MSC-derived exosomes and explores the prospects for their application in the treatment of CA.

**23.** Heliyon. 2023 Jun 28;9(7):e17710. doi: 10.1016/j.heliyon.2023.e17710. eCollection 2023 Jul.
**Cardiac imaging for the prediction of sudden cardiac arrest in patients with heart failure.**
De Lio F(1), Andreis A(1), De Lio G(1), Bellettini M(1), Pidello S(1), Raineri C(1), Gallone G(1), Alunni G(1), Frea S(1), Imazio M(2), Castagno D(1), De Ferrari GM(1).
**ABSTRACT**
The identification of heart failure (HF) patients at risk for arrhythmic sudden cardiac arrest (SCA) is a major challenge in the cardiovascular field. In addition to optimal medical treatment for HF, implantable cardioverter defibrillator (ICD) is currently recommended to prevent SCA in patients with reduced left ventricular ejection fraction (LVEF). The indication for an ICD implantation, in addition to HF etiology, New York Health Association (NYHA) class and life expectancy, mainly depends on LVEF value at echocardiography. However, the actual role of LVEF in the prediction of SCA has recently been debated, while newer multimodality imaging techniques with increased prognostic accuracy have been developed. Speckle tracking imaging allows the quantification of mechanical dispersion, a marker of electrophysiological heterogeneity predisposing to malignant arrhythmias, while advanced cardiac magnetic resonance techniques such as myocardial T1-mapping and extracellular volume fraction assessment allow the evaluation of interstitial diffuse fibrosis. Nuclear imaging is helpful for the appraisal of sympathetic nervous system dysfunction, while newer computed tomography techniques assessing myocardial delayed enhancement allow the identification of focal myocardial scar. This review will focus on the most modern advances in the

field of cardiovascular imaging along with its applications for the prediction of SCA in patients with HF. Modern artificial intelligence applications in cardiovascular imaging will also be discussed.

**24.** Am J Emerg Med. 2023 Jul 17;72:44-57. doi: 10.1016/j.ajem.2023.07.017. Online ahead of print.
**From flatline to lifeline: A scoping review of the Lazarus phenomenon.**
Mavrovounis G(1), Kontou M(2), Tsiotsikas O(2), Mermiri M(3), Tsolaki V(4), Beltsios E(5), Gourgoulianis K(6), Chalkias A(7), Pantazopoulos I(8).
**ABSTRACT**
BACKGROUND: The Lazarus phenomenon or autoresuscitation (autoROSC) is the return of spontaneous circulation (ROSC) after the termination of the cardiopulmonary resuscitation (CPR) efforts. PURPOSE: The purpose of the current scoping review is to present the available data in the literature regarding autoROSC. METHODS: We reviewed four scientific databases to identify all studies which reported autoROSC cases in patients who underwent CPR. We then extracted all information relevant to CPR and autoROSC. The review was performed according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses Extension for Scoping Reviews. RESULTS: We identified 66 studies describing 76 autoROSC cases. The majority of cardiac arrests were in-hospital (44, 57.89%). Median time from termination of CPR to autoROSC was 5 min. Regarding the outcome, 52 (77.61%) patients died and 11 (14.47%) patients had intact neurological outcome. A higher mortality rate was identified in patients with respiratory comorbidities. Overall, 24 (31.58%) patients survived. CONCLUSION: AutoROSC is probably an under-reported event in the medical community. Healthcare professionals should be aware of the phenomenon and actively monitor for it, when appropriate.

**25.** Ann Emerg Med. 2023 Aug;82(2):241-242. doi: 10.1016/j.annemergmed.2023.03.028.
**Rapid Implementation of Head-Up CPR Is Associated With Survival Based on a Prespecified Propensity Score Matching Analysis: Response to the February 2023 Journal Club.**
Moore JC(1), Labarère J(2), Lurie KG(1), Debaty GP(3), Pepe PE(4).
**NO ABSTRACT AVAILABLE**

**26.** J Clin Med. 2023 Jul 15;12(14):4704. doi: 10.3390/jcm12144704.
**Lazarus Phenomenon or the Return from the Afterlife-What We Know about Auto Resuscitation.**
Rzeźniczek P(1), Gaczkowska AD(1), Kluzik A(1)(2), Cybulski M(3), Bartkowska-Śniatkowska A(4), Grześkowiak M(1).
**ABSTRACT**
Autoresuscitation is a phenomenon of the heart during which it can resume its spontaneous activity and generate circulation. It was described for the first time by K. Linko in 1982 as a recovery after discontinued cardiopulmonary resuscitation (CPR). J.G. Bray named the recovery from death the Lazarus phenomenon in 1993. It is based on a biblical story of Jesus' resurrection of Lazarus four days after confirmation of his death. Up to the end of 2022, 76 cases (coming from 27 countries) of spontaneous recovery after death were reported; among them, 10 occurred in children. The youngest patient was 9 months old, and the oldest was 97 years old. The longest resuscitation lasted 90 min, but the shortest was 6 min. Cardiac arrest occurred in and out of the hospital. The majority of the patients suffered from many diseases. In most cases of the Lazarus phenomenon, the observed rhythms at cardiac arrest were non-shockable (Asystole, PEA). Survival time after death ranged from minutes to hours, days, and even months. Six patients with the Lazarus phenomenon reached full recovery without neurological impairment. Some of the causes leading to autoresuscitation presented here are hyperventilation and alkalosis, auto-PEEP, delayed drug action, hypothermia, intoxication, metabolic disorders (hyperkalemia), and unobserved minimal vital signs.

To avoid Lazarus Syndrome, it is recommended that the patient be monitored for 10 min after discontinuing CPR. Knowledge about this phenomenon should be disseminated in the medical community in order to improve the reporting of such cases. The probability of autoresuscitation among older people is possible.

**27.** Resuscitation. 2023 Jul 26:109916. doi: 10.1016/j.resuscitation.2023.109916. Online ahead of print.

**Head-to-Pelvis CT Imaging after Sudden Cardiac Arrest: Current Status and Future Directions.**

Branch KR(1), Nguyen ML(2), Kudenchuk PJ(3), Johnson NJ(4).

**ABSTRACT**

Causes for sudden circulatory arrest (SCA) can vary widely making early treatment and triage decisions challenging. Additionally, cardiopulmonary resuscitation (CPR), while a life-saving link in the chain of survival, can be associated with traumatic injuries. Computed tomography (CT) can identify many causes of SCA as well as its sequelae. However, the diagnostic and therapeutic impact of CT in survivors of SCA has not been reviewed to date. This general review outlines the rationale and potential applications of focused head, chest, and abdomen/pelvis CT as well as comprehensive head-to-pelvis CT imaging after SCA. CT has a diagnostic yield approaching 30% to identify causes of SCA while the addition of ECG-gated chest CT provides further information about coronary anatomy and cardiac function. Risks of CT include radiation exposure, contrast-induced kidney injury, and incidental findings. This review's findings suggest that routine head-to-pelvis CT can yield clinically actional findings with the potential to improve clinical outcome after SCA that merits further Investigation.

**28.** Resuscitation. 2023 Jul 26:109912. doi: 10.1016/j.resuscitation.2023.109912. Online ahead of print.

**Where have all the kidneys go? After ECPR, they are here to stay.**

Drabek T(1).

**NO ABSTRACT AVAILABLE**

**29.** Resuscitation. 2023 Jul 26:109917. doi: 10.1016/j.resuscitation.2023.109917. Online ahead of print.

**Impact of Time-to-Compression on Out-of-Hospital Cardiac Arrest Survival Outcomes: a National Registry Study.**

Ling Goh J(1), Pin Pek P(2), Man Chung Fook-Chong S(3), Fw Ho A(2), Javaid Siddiqui F(3), Sieu-Hon Leong B(4), Ren Hao Mao D(5), Ng W(6), Tiah L(7), Yih-Chong Chia M(8), Peng Tham L(9), Shahidah N(10), Arulanandam S(11), Eng Hock Ong M(12); PAROS Clinical Research Network.

**ABSTRACT**

OBJECTIVE: We aimed to quantify the association of no-flow interval in out-of-hospital cardiac arrests (OHCA) with the odds of neurologically favorable survival and survival to hospital discharge/ 30th day. Our secondary aim was to explore futility thresholds to guide clinical decisions, such as prehospital termination of resuscitation. METHODS: All OHCAs from 2012-2017 in Singapore were extracted. We examined the association between no-flow interval (continuous variable) and survival outcomes using univariate and multivariable logistic regressions. The primary outcome was survival with favorable cerebral performance (Glasgow-Pittsburgh Cerebral Performance Categories 1/2), the secondary outcome was survival to hospital discharge/ 30th day if not discharged. To determine futility thresholds, we plotted the adjusted probability of good neurological outcomes to no-flow interval. RESULTS: 12,771 OHCAs were analyzed. The per-minute adjusted OR when no-flow interval was incorporated as a continuous variable in the multivariable model was: good neurological

function- aOR 0.98 (95%CI: 0.97 - 0.98); survival to discharge- aOR 0.98 (95%CI: 0.98 - 0.99). Taking the 1% futility of survival line gave a no-flow interval cutoff of 12 mins (NPV 99%, sensitivity 85% and specificity 42%) overall and 7.5 mins for witnessed arrests. CONCLUSION: We demonstrated that prolonged no-flow interval had a significant effect on lower odds of favorable neurological outcomes, with medical futility occurring when no-flow interval was >12 mins (> 7.5 mins for witnessed arrest). Our study adds to the literature of the importance of early CPR and EMS response and provided a threshold beyond traditional 'down-times', which could aid clinical decisions in TOR or OHCA management.

**30.** Resuscitation. 2023 Jul 25:109909. doi: 10.1016/j.resuscitation.2023.109909. Online ahead of print.
**Out-of-hospital Cardiac Arrest: Do We Sometimes Terminate Resuscitative Efforts Too Soon?**
Bowman J(1), Ouchi K(2).
**NO ABSTRACT AVAILABLE**

**31.** Dtsch Med Wochenschr. 2023 Jul;148(14):921-933. doi: 10.1055/a-1936-5819. Epub 2023 Jul 7.
**[Out-of-hospital resuscitation: where are we today?].**
[Article in German]
Bemtgen X, Wengenmayer T.
**ABSTRACT**
In circulatory arrest, the first minutes and hours are crucial - rapid and adequate care can significantly increase the chances of survival. A large number of disciplines are involved in the recommendations and guidelines for out-of-hospital resuscitation. In particular, the European Resuscitation Council (ERC) as well as the European Society of Cardiology (ESC) and the American Heart Association (AHA) are leading the way. Both the ambulance service and the accepting hospital are faced with major challenges in this regard. This article will illustrate the most important steps during and after resuscitation and discuss innovations.

**32.** Clin Cardiol. 2023 Jul 26. doi: 10.1002/clc.24095. Online ahead of print.
**Sudden cardiac arrest in athletes and strategies to optimize preparedness.**
Malik A(1), Hanson J(2), Han J(3), Dolezal B(4), Bradfield JS(5), Boyle NG(5), Hsu JJ(2)(3).
**ABSTRACT**
Sudden cardiac arrest (SCA) is the leading cause of death in young athletes. Despite efforts to improve preparedness for cardiac emergencies, the incidence of out-of-hospital cardiac arrests in athletes remains high, and bystander awareness and readiness for SCA support are inadequate. Initiatives such as designing an emergency action plan (EAP) and mandating training in cardiopulmonary resuscitation (CPR) and automated external defibrillator use (AED) for team members and personnel can contribute to improved survival rates in SCA cases. This review provides an overview of SCA in athletes, focusing on identifying populations at the highest risk and evaluating the effectiveness of different screening practices in detecting conditions that may lead to SCA. We summarize current practices and recommendations for improving the response to SCA events, and we highlight the need for ongoing efforts to optimize preparedness through the implementation of EAPs and the training of individuals in CPR and AED use. Additionally, we propose a call to action to increase awareness and training in EAP development, CPR, and AED use for team members and personnel. To improve outcomes of SCA cases in athletes, it is crucial to enhance bystander awareness and preparedness for cardiac emergencies. Implementing EAPs and providing training in CPR and AED use for team members and personnel are essential steps toward improving survival rates in SCA cases.

**33.** Resuscitation. 2023 Aug;189:109870. doi: 10.1016/j.resuscitation.2023.109870. Epub 2023 Jun 14.
**Bystander CPR - Are we asking the right questions?**
Kini PK(1), Kanthimathinathan HK(2).
**NO ABSTRACT AVAILABLE**

**34.** Resuscitation. 2023 Aug;189:109868. doi: 10.1016/j.resuscitation.2023.109868. Epub 2023 Jun 9.
**What if prehospital ECPR was part of the solution?**
Hutin A(1), Lamhaut L(2).
**NO ABSTRACT AVAILABLE**

**35.** Am J Emerg Med. 2023 Aug;70:187. doi: 10.1016/j.ajem.2023.06.047. Epub 2023 Jun 28.
**Double sequential defibrillation for refractory ventricular fibrillation.**
Ao CV(1), Ho MP(2).
**NO ABSTRACT AVAILABLE**

**36.** Resuscitation. 2023 Aug;189:109899. doi: 10.1016/j.resuscitation.2023.109899. Epub 2023 Jul 5.
**Oxygen targets after cardiac arrest: A narrative review.**
Bray J(1), Skrifvars MB(2), Bernard S(3).
**ABSTRACT**
A significant focus of post-resuscitation research over the last decade has included optimising oxygenation. This has primarily occurred due to an improved understanding of the possible harmful biological effects of high oxygenation, particularly the neurotoxicity of oxygen free radicals. Animal studies and some observational research in humans suggest harm with the occurrence of severe hyperoxaemia (PaO2 > 300 mmHg) in the post-resuscitation phase. This early data informed in a change in treatment recommendations, with the International Liaison Committee on Resuscitation (ILCOR) recommending the avoidance of hyperoxaemia. However, the optimal oxygenation level for maximal survival has not yet been determined. Recent Phase 3 randomised control trials (RCTs) provide further insight into when oxygen titration should occur. The EXACT RCT suggested that decreasing oxygen fraction post-resuscitation in the prehospital setting, with limited ability to titrate and measure oxygenation, is too soon. The BOX RCT, suggests delaying titration to a normal level in intensive care may be too late. While further RCTs are currently underway in ICU cohorts, titration of oxygen early after arrival at hospital should be considered.

**37.** Eur Heart J Acute Cardiovasc Care. 2023 Jul 25:zuad088. doi: 10.1093/ehjacc/zuad088. Online ahead of print.
**Temperature Management after Cardiac Arrest: What is next after the TTM-2 and BOX trials?**
Taccone FS(1), Annoni F(1).
**ABSTRACT**
This commentary aims to summarize the main findings of the TTM-2 and BOX trials, to highlight pending questions regarding targeted temperature management after cardiac arrest and to explore how to improve the quality of future trials on this topic.

**IN-HOSPITAL CARDIAC ARREST**

**1.** J Clin Med. 2023 Jun 19;12(12):4136. doi: 10.3390/jcm12124136.
**Lactate to Albumin Ratio for Predicting Clinical Outcomes after In-Hospital Cardiac Arrest.**

Haschemi J(1), Müller CT(1), Haurand JM(1), Oehler D(1), Spieker M(1), Polzin A(1), Kelm M(1)(2), Horn P(1).

**ABSTRACT**

In-hospital cardiac arrest (IHCA) is associated with high mortality and poor neurological outcomes. Our objective was to assess whether the lactate-to-albumin ratio (LAR) can predict the outcomes in patients after IHCA. We retrospectively screened 75,987 hospitalised patients at a university hospital between 2015 and 2019. The primary endpoint was survival at 30-days. Neurological outcomes were assessed at 30 days using the cerebral performance category scale. 244 patients with IHCA and return of spontaneous circulation (ROSC) were included in this study and divided into quartiles of LAR. Overall, there were no differences in key baseline characteristics or rates of pre-existing comorbidities among the LAR quartiles. Patients with higher LAR had poorer survival after IHCA compared to patients with lower LAR: Q1, 70.4% of the patients; Q2, 50.8% of the patients; Q3, 26.2% of the patients; Q4, 6.6% of the patients ($p = 0.001$). Across increasing quartiles, the probability of a favourable neurological outcome in patients with ROSC after IHCA decreased: Q1: 49.2% of the patients; Q2: 32.8% of the patients; Q3: 14.7% of the patients; Q4: 3.2% of the patients ($p = 0.001$). The AUCs for predicting 30-days survival using the LAR were higher as compared to using a single measurement of lactate or albumin. The prognostic performance of LAR was superior to that of a single measurement of lactate or albumin for predicting survival after IHCA.

**2.** Resuscitation. 2023 Jul 3:109895. doi: 10.1016/j.resuscitation.2023.109895. Online ahead of print.

**Non-shockable rhythms: A parametric model for the immediate probability of return of spontaneous circulation.**

Unneland E(1), Norvik A(2), Bergum D(3), Buckler DG(4), Bhardwaj A(5), Christian Eftestøl T(6), Aramendi E(7), Nordseth T(8), Abella BS(9), Terje Kvaløy J(10), Skogvoll E(2).

**ABSTRACT**

BACKGROUND: Cardiac arrest can present with asystole, Pulseless Electrical Activity (PEA), or Ventricular Fibrillation/Tachycardia (VF/VT). We investigated the transition intensity of Return of spontaneous circulation (ROSC) from PEA and asystole during in-hospital resuscitation. MATERIALS AND METHODS: We included 770 episodes of cardiac arrest. PEA was defined as ECG with >12 QRS complexes per min, asystole by an isoelectric signal >5 seconds. The observed times of PEA to ROSC transitions were fitted to five different parametric time-to-event models. At values ≤0.1, transition intensities roughly represent next-minute probabilities allowing for direct interpretation. Different entities of PEA and asystole, dependent on whether it was the primary or a secondary rhythm, were included as covariates. RESULTS: The transition intensities to ROSC from primary PEA and PEA after asystole were unimodal with peaks of 0.12 at 3 min and 0.09 at 6 min, respectively. Transition intensities to ROSC from PEA after VF/VT, or following transient ROSC, exhibited high initial values of 0.32 and 0.26 at 3 minutes, respectively, but decreased. The transition intensity to ROSC from initial asystole and asystole after PEA were both about 0.01 and 0.02; while asystole after VF/VT had an intensity to ROSC of 0.15 initially which decreased. The transition intensity from asystole after temporary ROSC was constant at 0.08. CONCLUSION: The immediate probability of ROSC develops differently in PEA and asystole depending on the preceding rhythm and the duration of the resuscitation attempt. This knowledge may aid simple bedside prognostication and electronic resuscitation algorithms for monitors/defibrillators.

**3.** Ann Am Thorac Soc. 2023 Jul;20(7):1012-1019. doi: 10.1513/AnnalsATS.202205-393OC.

**Trends in Return of Spontaneous Circulation and Survival to Hospital Discharge for In-Intensive Care Unit Cardiac Arrests.**

Cagino LM(1), Moskowitz A(2), Nallamothu BK(1)(3), McSparron J(1), Iwashyna TJ(1)(3)(4); American Heart Association's Get With The Guidelines-Resuscitation Investigators.

**ABSTRACT**

Rationale: Nearly 3 in 5 in-hospital cardiac arrests (IHCAs) occur in the intensive care unit (ICU), yet large-scale data on the outcomes of in-ICU cardiac arrests have not been published for over a decade. Objectives: We sought to examine outcomes of in-ICU cardiac arrests, evaluating both achievement of return of spontaneous circulation (ROSC) and subsequent survival to hospital discharge and how these have changed over time and by type of cardiac arrest. Methods: This was an observational study using the Get With The Guidelines-Resuscitation registry, an American Heart Association-sponsored, prospective, multisite registry of IHCAs in the United States, including adults 18 years of age and older with a confirmed initial cardiac arrest occurring in the ICU who underwent resuscitation. Outcomes included achievement of ROSC and survival to hospital discharge. Multivariable hierarchical logistic regression adjusting for patient-level factors and hospitals as random effects was used to evaluate ROSC and survival. Results: A total of 114,371 adult, in-ICU IHCAs from January 2006 to December 2018 were studied. The mean age was 63.8 years, 41.3% were women, and 82.1% had a nonshockable initial rhythm. Of the 114,371 ICU cardiac arrests, 70,610 (61.7%) achieved ROSC, and 21,747 (19.0%) survived until hospital discharge. The rate of ROSC improved from 2006 to 2018 (unadjusted rate, 55.0-65.4%; adjusted odds ratio [OR] per year, 1.04; 95% confidence interval [CI], 1.03-1.05). There was an increase in overall survival to discharge during this time (unadjusted rate, 16.7-20.5%; adjusted OR per year, 1.03; 95% CI, 1.03-1.04). The survival to discharge rate of the 70,610 patients who achieved ROSC increased slightly (unadjusted rate, 30.3-31.4%; adjusted OR per year, 1.02; 95% CI, 1.01, 1.02). Conclusions: There is an increase in survival to discharge for patients who experienced a cardiac arrest in the ICU between 2006 and 2018. There is an increase in achievement of ROSC and post-ROSC survival to discharge, although the increase in achievement of ROSC was greater than the increase in post-ROSC survival.

**4.** Resuscitation. 2023 Jul 7:109903. doi: 10.1016/j.resuscitation.2023.109903. Online ahead of print.
**AWAreness during REsuscitation - II: A Multi-Center Study of Consciousness and Awareness in Cardiac Arrest.**
Parnia S(1), Keshavarz Shirazi T(2), Patel J(3), Tran L(3), Sinha N(3), O'Neill C(2), Roellke E(2), Mengotto A(2), Findlay S(4), McBrine M(5), Spiegel R(6), Tarpey T(7), Huppert E(2), Jaffe I(2), Gonzales AM(2), Xu J(2), Koopman E(2), Perkins GD(8), Vuylsteke A(9), Bloom BM(10), Jarman H(11), Nam Tong H(12), Chan L(13), Lyaker M(14), Thomas M(15), Velchev V(16), Cairns CB(17), Sharm R(18), Kulstad E(19), Scherer E(20), O'Keeffe T(21), Foroozesh M(22), Abe O(23), Ogedegbe C(24), Girgis A(25), Pradhan D(2), Deakin CD(26).
**ABSTRACT**
INTRODUCTION: Cognitive activity and awareness during cardiac arrest (CA) are reported but ill understood. This first of a kind study examined consciousness and its underlying electrocortical biomarkers during cardiopulmonary resuscitation (CPR). METHODS: In a prospective 25-site in-hospital study, we incorporated a) independent audiovisual testing of awareness, including explicit and implicit learning using a computer and headphones, with b) continuous real-time electroencephalography(EEG) and cerebral oxygenation(rSO2) monitoring into CPR during in-hospital CA (IHCA). Survivors underwent interviews to examine for recall of awareness and cognitive experiences. A complementary cross-sectional community CA study provided added insights regarding survivors' experiences. RESULTS: Of 567 IHCA, 53(9.3%) survived, 28 of these (52.8%) completed interviews, and 11(39.3%) reported CA memories/perceptions suggestive of consciousness. Four categories of experiences emerged: 1) emergence from coma during CPR (CPR-induced consciousness [CPRIC]) 2/28(7.1%), or 2) in the post-resuscitation period 2/28(7.1%), 3) dream-like experiences 3/28(10.7%), 4) transcendent recalled experience of death (RED) 6/28(21.4%). In the cross-sectional arm, 126 community CA survivors' experiences reinforced these categories and identified another: delusions (misattribution of medical events). Low survival limited the ability to examine for implicit learning. Nobody identified the visual image, 1/28(3.5%) identified the auditory stimulus. Despite marked cerebral ischemia (Mean rSO2=43%) normal EEG activity (delta, theta and alpha) consistent with consciousness emerged as long as 35-60 minutes into CPR.

CONCLUSIONS: Consciousness. awareness and cognitive processes may occur during CA. The emergence of normal EEG may reflect a resumption of a network-level of cognitive activity, and a biomarker of consciousness, lucidity and RED (authentic "near-death" experiences).

**5.** Resusc Plus. 2023 Jun 8;14:100410. doi: 10.1016/j.resplu.2023.100410. eCollection 2023 Jun.
**In-situ simulations to detect patient safety threats during in-hospital cardiac arrest.**
Stærk M(1)(2)(3)(4), Lauridsen KG(2)(4)(5), Johnsen J(4)(6), Løfgren B(2)(4)(7), Krogh K(4)(8).
**ABSTRACT**
INTRODUCTION: Errors during treatment may affect patient outcomes and can include errors in treatment algorithms, teamwork, and system errors. In-hospital cardiac arrests (IHCA) require immediate and effective treatment, and delays are known to reduce survival. In-situ simulation is a tool that can be used to study emergency responses, including IHCA. We investigated system errors discovered during unannounced in-situ simulated IHCA. METHOD: This multicenter cohort study included unannounced, full-scale IHCA in-situ simulations followed by a debriefing based on PEARLS with plus-delta used in the analysis phase. Simulations and debriefings were video-recorded for subsequent analysis. System errors observed were categorized by thematic analysis and analyzed for clinical implications. Errors related to treatment algorithm and clinical performance were excluded. RESULTS: We conducted 36 in-situ simulations across 4 hospitals with a total discovery of 30 system errors. On average, we discovered 0.8 system errors per simulation within the categories: human, organizational, hardware, or software errors. Of these, 25 errors (83%) had direct treatment consequences. System errors caused treatment delays in 15 cases, a need for alternative actions in 6 cases, omission of actions in 4 cases, and other consequences in 5 cases. CONCLUSION: Using unannounced in-situ simulations, we identified almost one system error per simulation, and most of these errors were deemed to impact treatment negatively. The errors affected treatment by either causing delays, need for alternative treatment options, or omitting treatment actions. We suggest that hospitals focus on the need for regular testing of the emergency response by conducting full-scale unannounced in-situ simulations. This should be a priority to improve patient safety and care.

**6.** Front Cardiovasc Med. 2023 Jul 3;10:1175731. doi: 10.3389/fcvm.2023.1175731. eCollection 2023.
**Type 2 diabetes and in-hospital sudden cardiac arrest in ST-elevation myocardial infarction in the US.**
Mhaimeed O(1)(2), Pillai K(1), Dargham S(3), Al Suwaidi J(4), Jneid H(5), Abi Khalil C(1)(4)(6).
**ABSTRACT**
AIMS: We aimed to assess the impact of diabetes on sudden cardiac arrest (SCA) in US patients hospitalized for ST-elevation myocardial infarction (STEMI). METHODS: We used the National Inpatient Sample (2005-2017) data to identify adult patients with STEMI. The primary outcome was in-hospital SCA. Secondary outcomes included in-hospital mortality, ventricular tachycardia (VT), ventricular fibrillation (VF), cardiogenic shock (CS), acute renal failure (ARF), and the revascularization strategy in SCA patients. RESULTS: SCA significantly increased from 4% in 2005 to 7.6% in 2018 in diabetes patients and from 3% in 2005 to 4.6% in 2018 in non-diabetes ones ($p < 0.001$ for both). Further, diabetes was associated with an increased risk of SCA [aOR = 1.432 (1.336-1.707)]. In SCA patients with diabetes, the mean age (SD) decreased from 68 (13) to 66 (11) years old, and mortality decreased from 65.7% to 49.3% during the observation period ($p < 0.001$). Compared to non-diabetes patients, those with T2DM had a higher adjusted risk of mortality, ARF, and CS [aOR = 1.72 (1.62-1.83), 1.52 (1.43-1.63), 1.25 (1.17-1.33); respectively] but not VF or VT. Those patients were more likely to undergo revascularization with CABG [aOR = 1.197 (1.065-1.345)] but less likely to undergo PCI [aOR = 0.708 (0.664-0.754)]. CONCLUSION: Diabetes is associated with an increased risk of sudden cardiac arrest in ST-elevation myocardial infarction. It is also associated with a higher mortality risk in SCA patients. However, the recent temporal mortality trend in SCA patients shows a steady decline, irrespective of diabetes.

**7.** Zhonghua Xin Xue Guan Bing Za Zhi. 2023 Jul 24;51(7):790-795. doi: 10.3760/cma.j.cn112148-20221228-01019.
**[Advances in the prognostic model of in-hospital cardiac arrest].**
[Article in Chinese; Abstract available in Chinese from the publisher]
Wei SX(1), Zheng W(2), Sang WT(1), Ma YY(1), Zhao X(1), Xie X(1), Xu F(2).
**NO ABSTRACT AVAILABLE**

**8.** Resusc Plus. 2023 Jul 3;15:100425. doi: 10.1016/j.resplu.2023.100425. eCollection 2023 Sep.
**Epidemiology, risk factors and outcomes associated with in-hospital reflex-mediated cardiac arrest.**
Pham TT(1), Malhotra A(1), Loo T(2), Pearce AK(1), Sell RE(1).
**ABSTRACT**
AIM OF THE STUDY: Overactivation of the parasympathetic nervous system can lead to reflex syncope (RS) and, in extreme cases, trigger an unusual and underrecognized form of cardiac arrest. We characterized the epidemiology and prognosis of reflex-mediated cardiac arrest (RMCA) and hypothesized it is associated with intervenable patient factors. METHODS: This retrospective case-control study examined RMCAs at two academic hospitals from 1/2016 to 6/2022 using a resuscitation quality improvement database. RMCA cases were identified as cardiac arrests preceded by vagal trigger(s). Cases of RS, defined as syncope with bradycardia and hypotension preceded by vagal trigger(s), between 1/2021 and 12/2021 were used as controls. For the secondary analysis, RMCA outcomes were compared to in-hospital cardiac arrest (IHCA) of other causes. RESULTS: We identified 46 RMCA and 67 RS cases. Compared to RS patients, RMCA patients were more likely to have spinal cord injury (13.0% vs 1.5%, $p = 0.02$). Airway clearance i.e., coughing and suctioning triggered a higher proportion of RMCA events than RS events (23.9% vs 3.0%, $p < 0.01$). Compared to 1,021 IHCAs of other causes, RMCAs had 100% return of spontaneous circulation, were more likely to survive to discharge (84.8% vs 36.2%, $p < 0.001$) and have favorable neurological outcomes (cerebral performance category 1 or 2, 58.7% vs 26.9%, $p < 0.001$). CONCLUSIONS: RMCA has a favorable prognosis compared to other IHCAs and is potentially preventable. Spinal cord injury and airway clearance were patient factors significantly associated with RMCA.

**INJURIES AND CPR**

**1.** Resusc Plus. 2023 Jun 23;15:100418. doi: 10.1016/j.resplu.2023.100418. eCollection 2023 Sep.
**Collapse-related traumatic intracranial hemorrhage following out-of-hospital cardiac arrest: A multicenter retrospective cohort study.**
Inoue F(1), Hongo T(2)(3), Ichiba T(1), Otani T(1), Naito H(1), Kosaki Y(2), Murakami Y(2)(4), Iida A(2)(5), Yumoto T(2), Naito H(2), Nakao A(2).
**ABSTRACT**
BACKGROUND: Sudden loss of consciousness as a result of cardiac arrest can cause severe traumatic head injury. Collapse-related traumatic intracranial hemorrhage (CRTIH) following out-of-hospital cardiac arrest (OHCA) may be linked to poor neurological outcomes; however, there is a paucity of data on this entity. This study aimed to investigate the frequency, characteristics, and outcomes of CRTIH following OHCA. METHODS: Adult patients treated post-OHCA at 5 intensive care units who had head computed tomography (CT) scans were included in the study. CRTIH following OHCA was defined as a traumatic intracranial injury from collapse due to sudden loss of consciousness associated with OHCA. Patients with and without CRTIH were compared. The primary outcome assessed was the frequency of CRTIH following OHCA. Additionally, the clinical features, management, and consequences of CRTIH were analyzed descriptively. RESULTS: CRTIH following OHCA was observed in 8 of 345 enrolled patients (2.3%). CRTIH was more frequent after collapse

outside the home, from a standing position, or due to cardiac arrest with a cardiac etiology. Intracranial hematoma expansion on follow up CT was seen in 2 patients; both received anticoagulant therapy, and one required surgical evacuation. Three patients (37.5%) with CRTIH had favorable neurological outcomes 28 days after collapse. CONCLUSIONS: Despite its rare occurrence, physicians should pay special attention to CRTIH following OHCA during the post-resuscitation care period. Larger prospective studies are warranted to provide a more explicit picture of this clinical condition.

**2.** J Trauma Acute Care Surg. 2023 Jul 5. doi: 10.1097/TA.0000000000004092. Online ahead of print.
**Injury pattern and Clinical outcome in patients with and without Chest Wall Injury after Cardiopulmonary Resuscitation.**
Hadesi P(1), Rossi Norrlund R(2), Caragounis EC.
**ABSTRACT**
BACKGROUND: Cardiopulmonary resuscitation (CPR), although lifesaving may cause chest wall injury (CWI) due to the physical force exerted on the thorax. The impact of CWI on clinical outcome in this patient group is unclear. The primary aim of this study was to investigate the incidence of CPR-related CWI and the secondary aim to study injury pattern, length of stay (LOS) and mortality in patients with and without CWI. METHODS: This is a retrospective study of adult patients who were admitted to our hospital due to cardiac arrest (CA) during 2012-2020. Patients were identified in the XBlindedX CPR Registry and those undergoing CT of the thorax within 2 weeks after CPR were included. Patients with traumatic CA, chest wall surgery prior or after CA were excluded. Demographic data, type and length of CPR, type of CWI, length of stay (LOS) on Mechanical Ventilator (MV), in Intensive Care Unit (ICU) and in Hospital (H), and mortality were studied. RESULTS: Out of 1715 CA patients, 245 met the criteria for inclusion. The majority (79%) of the patients suffered from CWI. Chondral injuries and rib fractures were more common than sternum fractures (95% vs. 57%) and 14% had a radiological flail segment. Patients with CWI were older (66.5 ± 15.4 vs. 52.5 ± 15.2, $p < 0.001$). No difference was seen in MV-LOS (3 (0-43) vs. 3 (0-22), $p = 0.430$), ICU-LOS (3 (0-48) vs. 3 (0-24), $p = 0.427$) and H-LOS (5.5 (0-85) vs. 9.0 (1-53), $p = 0.306$) in patients with or without CWI. Overall mortality within 30 days was higher with CWI (68% vs. 47%, $p = 0.007$). CONCLUSIONS: Chest wall injuries are common after CPR and 14% of patients had a flail segment on CT. Elderly patients have an increased risk of CWI, and a higher overall mortality is seen in patients with CWI.

**3.** ANZ J Surg. 2023 Jul 17. doi: 10.1111/ans.18621. Online ahead of print.
**Total vascular exclusion and delayed resection in major cardiopulmonary resuscitation related liver injury.**
Lockie E(1)(2), Yoshino O(1)(3), Choi J(1)(4).
**NO ABSTRACT AVAILABLE**

**4.** Resuscitation. 2023 Jul 25:109911. doi: 10.1016/j.resuscitation.2023.109911. Online ahead of print.
**Kidney-Specific Biomarkers for Predicting Acute Kidney Injury Following Cardiac Arrest.**
Berlin N(1), Pawar RD(2), Liu X(1), Balaji L(1), Morton AC(1), Silverman J(1), Li F(1), Issa MS(1), Roessler LL(3), Holmberg MJ(4), Shekhar AC(1), Donnino MW(5), Moskowitz A(6), V Grossestreuer A(7).
**ABSTRACT**
AIM: To evaluate the performance of kidney-specific biomarkers (neutrophil gelatinase-associated lipocalin (NGAL), kidney injury molecule-1 (KIM-1), and cystatin-C) in early detection of acute kidney

injury (AKI) following cardiac arrest (CA) when compared to serum creatinine. METHODS: Adult CA patients who had kidney-specific biomarkers of AKI collected within 12 hours of return of spontaneous circulation (ROSC) were included. The association between renal biomarker levels post-ROSC and the development of KDIGO stage III AKI within 7 days of enrollment were assessed as well as their predictive value of future AKI development, neurological outcomes, and survival to discharge. RESULTS: Of 153 patients, 54 (35%) developed stage III AKI within 7 days, and 98 (64%) died prior to hospital discharge. Patients who developed stage III AKI, compared to those who did not, had higher median levels of creatinine, NGAL, and cystatin-C ($p<0.001$ for all). There was no statistically significant difference in KIM-1 between groups. No biomarker outperformed creatinine in the ability to predict stage III AKI, neurological outcomes, or survival outcomes ($p>0.05$ for all). However, NGAL, cystatin-C, and creatinine all performed better than KIM-1 in their ability to predict AKI development ($p<0.01$ for all). CONCLUSION: In post-CA patients, creatinine, NGAL, and cystatin-C (but not KIM-1) measured shortly after ROSC were higher in patients who subsequently developed AKI. No biomarker was statistically superior to creatinine on its own for predicting the development of post-arrest AKI.

**CAUSE OF THE ARREST**

**1.** Wilderness Environ Med. 2023 Jun 23:S1080-6032(23)00096-0. doi: 10.1016/j.wem.2023.05.004. Online ahead of print.

**Out of Hospital Cardiac Arrests during Mass-Participation Endurance Events: A Case Series.**

Morton S(1), Goonetilleke C(2), Taylor M(2), Beach N(2).

**ABSTRACT**

INTRODUCTION: Mass-participation endurance events take place throughout the United Kingdom. Although out-of-hospital cardiac arrests (OHCAs) occur during these events, little is known about them. This case series aims to describe the number, type, etiology, and outcome of OHCAs treated by a UK-based specialist sports medicine provider over a period of 8 y. METHODS: The medical records of a UK-based sports medicine provider were reviewed from 2014 to 2022. Anonymized information from OHCAs during this time was recorded. This included type of event, patient demographics, details of OHCA, and patient outcomes. RESULTS: Ten OHCAs were identified during the course of 110 sporting events. These included the cases of 9 participants and 1 spectator. Return of spontaneous circulation (ROSC) was achieved on-site in all patients. Eight survived beyond 24 h and achieved a full neurological recovery. Seventy percent of these patients achieved ROSC within 4 min of cardiopulmonary resuscitation being initiated. The 2 patients who died both presented with a nonshockable rhythm. CONCLUSIONS: OHCAs during mass-participation endurance events are rare. However, medical providers must be prepared to respond promptly. Quick interventions can result in a full neurological recovery.

**2.** Indian J Crit Care Med. 2023 Jun;27(6):403-410. doi: 10.5005/jp-journals-10071-24477.

**Clinical Profile, Corticosteroid Usage and Predictors of Mortality in Near-hanging Patients: A Five-year, Single-center Retrospective Study.**

Ramadoss R(1), Sekar D(1), Rameesh M(1), Saibaba J(1), Raman D(1).

**ABSTRACT**

BACKGROUND: Hanging is the most common method of suicide in India. When near-hanging patients reach the hospital for treatment, their neurological outcome ranges from full recovery to severe neurological impairment or death. This study looked at the clinical profile, usage of corticosteroids and predictors of mortality in near-hanging patients. MATERIALS AND METHODS: This retrospective study was conducted from May 2017 to April 2022. Demographic, clinical, and

treatment details were collected from case records. Neurological outcome at discharge was assessed using the Glasgow Outcome Scale (GOS). RESULTS: The study involved 323 patients, 60% of men with a median (interquartile range) age of 30 (20-39). At the time of admission, the Glasgow Coma Scale (GCS) ≤8 in 110 (34%) patients, hypotension was present in 43 (13.3%) of patients, and 21 (6.5%) had hanging-induced cardiac arrest. About 101 patients required intensive care unit care. Corticosteroid therapy was given to 219 patients (67.8%) as part of anti-cerebral edema measures. Good neurological recovery was found (GOS-5) in 84.2% of patients, and the death rate (GOS-1) was 9.3%. Univariate logistic regression showed that usage of corticosteroids is significantly associated with poor survival ($p < 0.02$, odds ratio 4.7). In the multivariable logistic regression analysis, GCS ≤8, hypotension, need for intensive care, hanging-induced cardiac arrest, aspiration pneumonia, and severe cerebral edema were found to be significantly associated with mortality. CONCLUSION: The majority of near-hanging patients had a good neurological recovery. Corticosteroids were used in two-thirds of the study population. There were multiple variables associated with mortality.

**3.** JAMA Netw Open. 2023 Jul 3;6(7):e2321465. doi: 10.1001/jamanetworkopen.2023.21465.
**Frailty and Outcomes Following Cardiopulmonary Resuscitation for Perioperative Cardiac Arrest.**
Allen MB(1), Orkaby AR(2)(3), Justice S(1), Hall DE(4)(5)(6)(7), Hu FY(8), Cooper Z(8)(9), Bernacki RE(9)(10)(11), Bader AM(1)(9).

**ABSTRACT**

IMPORTANCE: Frailty is associated with mortality following surgery and cardiopulmonary resuscitation (CPR) for in-hospital cardiac arrest. Despite the growing focus on frailty as a basis for preoperative risk stratification and concern that CPR in patients with frailty may border on futility, the association between frailty and outcomes following perioperative CPR is unknown. OBJECTIVE: To determine the association between frailty and outcomes following perioperative CPR. DESIGN, SETTING, AND PARTICIPANTS: This longitudinal cohort study of patients used the American College of Surgeons National Surgical Quality Improvement Program, including more than 700 participating hospitals in the US, from January 1, 2015, through December 31, 2020. Follow-up duration was 30 days. Patients 50 years or older undergoing noncardiac surgery who received CPR on postoperative day 0 were included; patients were excluded if data required to determine frailty, establish outcome, or perform multivariable analyses were missing. Data were analyzed from September 1, 2022, through January 30, 2023. EXPOSURES: Frailty defined as Risk Analysis Index (RAI) of 40 or greater vs less than 40. OUTCOMES AND MEASURES: Thirty-day mortality and nonhome discharge. RESULTS: Among the 3149 patients included in the analysis, the median age was 71 (IQR, 63-79) years, 1709 (55.9%) were men, and 2117 (69.2%) were White. Mean (SD) RAI was 37.73 (6.18), and 792 patients (25.9%) had an RAI of 40 or greater, of whom 534 (67.4%) died within 30 days of surgery. Multivariable logistic regression adjusting for race, American Society of Anesthesiologists physical status, sepsis, and emergency surgery demonstrated a positive association between frailty and mortality (adjusted odds ratio [AOR], 1.35 [95% CI, 1.11-1.65]; P = .003). Spline regression analysis demonstrated steadily increasing probability of mortality and nonhome discharge with increasing RAI above 37 and 36, respectively. Association between frailty and mortality following CPR varied by procedure urgency (AOR for nonemergent procedures, 1.55 [95% CI, 1.23-1.97]; AOR for emergent procedures, 0.97 [95% CI, 0.68-1.37]; P = .03 for interaction). An RAI of 40 or greater was associated with increased odds of nonhome discharge compared with an RAI of less than 40 (AOR, 1.85 [95% CI, 1.31-2.62]; P < .001). CONCLUSIONS AND RELEVANCE: The findings of this cohort study suggest that although roughly 1 in 3 patients with an RAI of 40 or greater survived at least 30 days following perioperative CPR, higher frailty burden was associated with increased mortality and greater risk of nonhome discharge among survivors. Identifying patients who are undergoing surgery

and have frailty may inform primary prevention strategies, guide shared decision-making regarding perioperative CPR, and promote goal-concordant surgical care.

**4.** Front Med (Lausanne). 2023 Jun 15;10:1198078. doi: 10.3389/fmed.2023.1198078. eCollection 2023.

**Characteristics and neurological survival following intraoperative cardiac arrest in a Swiss University Hospital: a 7-year retrospective observational cohort study.**

Fuchs A(1)(2), Franzmeier L(1), Cheseaux-Carrupt M(1), Kaempfer M(1), Disma N(2), Pietsch U(3)(4), Huber M(1), Riva T(1), Greif R(5)(6)(7).

**ABSTRACT**

INTRODUCTION: Little is known about intraoperative cardiac arrest during anesthesia care. In particular, data on characteristics of cardiac arrest and neurological survival are scarce. METHODS: We conducted a single-center retrospective observational study evaluating anesthetic procedures from January 2015 until December 2021. We included patients with an intraoperative cardiac arrest and excluded cardiac arrest outside of the operating room. The primary outcome was the return of spontaneous circulation (ROSC). Secondary outcomes were sustained ROSC over 20 min, 30-day survival, and favorable neurological outcome according to Clinical Performance Category (CPC) 1 and 2. RESULTS: We screened 228,712 anesthetic procedures, 195 of which met inclusion criteria and were analyzed. The incidence of intraoperative cardiac arrest was 90 (CI 95% 78-103) in 100,000 procedures. The median age was 70.5 [60.0; 79.4] years, and two-thirds of patients (n = 135; 69.2%) were male. Most of these patients with cardiac arrest had ASA physical status IV (n = 83; 42.6%) or V (n = 47; 24.1%). Cardiac arrest occurred more frequently (n = 104; 53.1%) during emergency procedures than elective ones (n = 92; 46.9%). Initial rhythm was pre-dominantly non-shockable with pulseless electrical activity mostly. Most patients (n = 163/195, 83.6%; CI 95 77.6-88.5%) had at least one instance of ROSC. Sustained ROSC over 20 min was achieved in most patients with ROSC (n = 147/163; 90.2%). Of the 163 patients with ROSC, 111 (68.1%, CI 95 60.4-75.2%) remained alive after 30 days, and most (n = 90/111; 84.9%) had favorable neurological survival (CPC 1 and 2). CONCLUSION: Intraoperative cardiac arrest is rare but is more likely in older patients, patients with ASA physical status ≥IV, cardiac and vascular surgery, and emergency procedures. Patients often present with pulseless electrical activity as the initial rhythm. ROSC can be achieved in most patients. Over half of the patients are alive after 30 days, most with favorable neurological outcomes, if treated immediately

**5.** Resusc Plus. 2023 Jun 8;14:100406. doi: 10.1016/j.resplu.2023.100406. eCollection 2023 Jun.

**A systematic review of interventions for resuscitation following drowning.**

Bierens J(1), Bray J(2), Abelairas-Gomez C(3), Barcala-Furelos R(4), Beerman S(5), Claesson A(6), Dunne C(7), Fukuda T(8), Jayashree M(9), T Lagina A(10), Li L(10)(11), Mecrow T(12), Morgan P(1), Schmidt A(13), Seesink J(14), Sempsrott J(15), Szpilman D(16), Thom O(17), Tobin J(18), Webber J(19), Johnson S(20), Perkins GD(20); International Liaison Committee on Resuscitation BLS/AED Task Force.

**ABSTRACT**

OBJECTIVES: The International Liaison Committee on Resuscitation, in collaboration with drowning researchers from around the world, aimed to review the evidence addressing seven key resuscitation interventions: 1) immediate versus delayed resuscitation; (2) compression first versus ventilation first strategy; (3) compression-only CPR versus standard CPR (compressions and ventilations); (4) ventilation with and without equipment; (5) oxygen administration prior to hospital arrival; (6) automated external defibrillation first versus cardiopulmonary resuscitation first strategy; (7) public access defibrillation programmes. METHODS: The review included studies relating to

adults and children who had sustained a cardiac arrest following drowning with control groups and reported patient outcomes. Searches were run from database inception through to April 2023. The following databases were searched Ovid MEDLINE, Pre-Medline, Embase, Cochrane Central Register of Controlled Trials. Risk of bias was assessed using the ROBINS-I tool and the certainty of evidence was assessed using Grading of Recommendations Assessment, Development and Evaluation. The findings are reported as a narrative synthesis. RESULTS: Three studies were included for two of the seven interventions (2,451 patients). No randomised controlled trials were identified. A retrospective observational study reported in-water resuscitation with rescue breaths improved patient outcomes compared to delayed resuscitation on land (n = 46 patients, very low certainty of evidence). The two observational studies (n = 2,405 patients), comparing compression-only with standard resuscitation, reported no difference for most outcomes. A statistically higher rate of survival to hospital discharge was reported for the standard resuscitation group in one of these studies (29.7% versus 18.1%, adjusted odds ratio 1.54 (95% confidence interval 1.01-2.36) (very low certainty of evidence). CONCLUSION: The key finding of this systematic review is the paucity of evidence, with control groups, to inform treatment guidelines for resuscitation in drowning.

**6.** Clin Infect Dis. 2023 Jul 14:ciad422. doi: 10.1093/cid/ciad422. Online ahead of print.
**Out-of-Hospital Cardiac Arrest in individuals with Human Immunodeficiency Virus infection - A nationwide population-based cohort study.**
Garcia R(1)(2)(3), Warming PE(1), Hansen CJ(1), Rajan D(1), Torp-Pedersen C(4)(5), Benfield T(6)(7), Folke F(8)(9)(10), Tfelt-Hansen J(1)(11).
**ABSTRACT**
BACKGROUND: Little data exist on the risk and outcomes of out-of-hospital cardiac arrest (OHCA) in people with HIV (PWH). We aimed to describe OHCA in PWH as compared to the general population in terms of incidence, characteristics, and survival. METHODS: This nationwide study assessed all individuals aged 18-85 years between 2001 and 2019 in Denmark. Cumulative incidence of OHCA was computed using cause-specific Cox models accounting for competing risk of death. RESULTS: Among 6 565 309 individuals, 6 925 (median age 36 [IQR 28-44], 74% males) were infected at some point with HIV. Incidence of OHCA was 149 (95% CI 123-180)/100 000 person-years in PWH versus 64 (95% CI 64-65)/100 000 person-years in non-HIV patients (P<0.001). Age at the time of cardiac arrest was 52 (IQR 44-61) years in PWH (vs. 69 [IQR 59-77] years in individuals without HIV; P<0.001). In a multivariable model adjusted for age, sex, hypertension, diabetes, heart failure, ischemic heart disease, atrial fibrillation, chronic obstructive pulmonary disease, cancer and renal failure, PWH had a two-fold higher risk of OHCA (HR 2.84, 95% CI 2.36-3.43; P<0.001). Thirty-day mortality (89% vs 88%; P=0.80) was comparable to individuals without HIV. CONCLUSIONS: HIV is an independent risk factor of OHCA and OHCA victims with HIV are much younger than those without HIV. Almost 90% of PWH died one month after OHCA. Further research should strive to find out how to reduce OHCA occurrence in this population.

**7.** Diagnostics (Basel). 2023 Jun 24;13(13):2157. doi: 10.3390/diagnostics13132157.
**Increased Epicardial Adipose Tissue and Heart Characteristics Are Correlated with BMI and Predict Silent Myocardial Infarction in Sudden Cardiac Death Subjects: An Autopsy Study.**
Hogea T(1)(2)(3), Noemi N(1), Suciu BA(4), Brinzaniuc K(4), Chinezu L(5), Arbănași EM(3)(6)(7), Kaller R(3)(6), Carașca C(1)(2), Arbănași EM(8), Vunvulea V(4)(9), Hălmaciu I(2)(9), Mureșan AV(6)(7), Russu E(6)(7), Ciucanu CC(6), Radu CM(10), Radu CC(1)(2).
**ABSTRACT**

Sudden cardiac death (SCD) is a significant global public health issue and the leading cause of death worldwide. Its etiopathogenesis is complex and multilayered, involving dynamic factors interacting with a preexistent cardiovascular pathology, frequently unknown, and resulting in cardiac rhythm disorders and cardiac arrest; Methods: This study conducted a retrospective descriptive analysis over a one-year period, identifying 321 autopsy cases of sudden deaths from the Institute of Legal Medicine in Mures County, Romania, in 2019. From the 321 sudden death cases, 189 autopsy reports were selected for analysis based on inclusion and exclusion; Results: The autopsies had a mean age of 61.16 years and included 140 males and 49 females. No significant differences were found between the silent myocardial infarction (SMI) and no-SMI groups regarding demographic data. The SMI group exhibited higher thickness of LV (left ventricle), IV (interventricular septum), EAT LCx (epicardial adipose tissue at left circumflex artery), EAT LAD (epicardial adipose tissue at left anterior descending artery), heart weight, and BMI (body mass index). The left coronary artery showed a higher incidence of type V plaques, while the right coronary artery showed higher incidences of type V and type VI plaque. The SMI group also exhibited a higher incidence of moderate and severe valvular atherosclerosis, severe left ventricle dilatation, and a lower incidence of mild left ventricle dilatation. In addition, the SMI group showed a higher presence of contraction band necrosis on histological examination. Multivariate analysis revealed that type V and type VI plaques for the right and left coronary arteries, moderate and severe valvular atherosclerosis, severe left ventricle dilatation, heart weight, EAT LCx, EAT LAD, LV thickness, IV thickness, BMI, and the presence of contraction band necrosis are all independent predictors of SMI; Conclusions: The findings suggest that SCD is a complex condition, and its etiopathogenesis involves dynamic factors interacting with pre-existing cardiovascular pathology. The risk factors of SCD are similar to those of ischemic heart disease. The findings of this study could guide clinicians in identifying patients at risk of SCD and implementing preventive measures.

**8.** Am J Cardiol. 2023 Aug 1;200:124-127. doi: 10.1016/j.amjcard.2023.05.009. Epub 2023 Jun 12.
**Interplay Between Fitness, Systolic Blood Pressure and Sudden Cardiac Death (from a Cohort Study).**
Laukkanen JA(1), Kurl S(2), Kunutsor SK(3).
**ABSTRACT**
Modifiable risk factors, such as blood pressure and cardiorespiratory fitness (CRF) play a role in the genesis of sudden cardiac death (SCD). However, data on their joint contributions to SCD risk are scarce. We aimed to evaluate the interplay between systolic blood pressure (SBP), CRF, and SCD risk in a cohort of men. Resting SBP was measured using a random-zero sphygmomanometer and CRF was assessed using a respiratory gas exchange analyzer during clinical exercise testing at baseline in 2,291 men aged 42 to 61 years. SBP was classified as normal and high (<140 and ≥140 mm Hg, respectively) and CRF as low, medium, and high. Cox regression analysis was used to estimate hazard ratios (HRs) with 95% confidence intervals (CIs) for SCD. A total of 262 SCDs occurred during a median follow-up of 28.2 years. Comparing high versus normal SBP, the multivariable-adjusted HR (95% CI) for SCD was 1.35 (1.03 to 1.76). Comparing low versus high CRF levels, the corresponding adjusted HR (95% CI) for SCD was 1.81 (1.23 to 2.65). The HRs remained similar when SBP was further adjusted for CRF and CRF was further adjusted for SBP. Men with high SBP and low CRF compared with normal SBP and medium-high CRF, had an increased risk of SCD (HR 2.67, 95% CI 1.76 to 4.05), with no significant evidence of an association between men with high SBP and medium-high CRF and SCD risk (HR 1.38, 95% CI 0.84 to 2.26). There was modest evidence of an additive interaction between SBP and CRF in relation to SCD. In conclusion, there exists an interplay between SBP, CRF, and SCD risk in middle-aged and older men. Medium to high CRF levels may mitigate the increased risk of SCD in subjects with high SBP.

**END-TIDAL $CO_2$**

No articles identified.

**ORGAN DONATION**

**1.** Isr Med Assoc J. 2023 Jun;25(6):434-437.
**Outcome of Kidney Transplantation in Israel Following Uncontrolled Donation after Cardiocirculatory Determination of Death.**
Cohen JD(1), Kaplan T(2), Fink T(3), Grozovsky K(3), Strugo R(4), Kagan I(4), Ashkenazi T(5).
**ABSTRACT**
BACKGROUND: A limited program for kidney donation from uncontrolled donation after cardiocirculatory determination of death (uDCDD) was implemented at four hospitals in Israel in close cooperation with Magen David Adom (MDA), the national emergency medical service. OBJECTIVES: To assess the outcome of transplantations performed between January 2017 and June 2022. METHODS: Donor data included age, sex, and cause of death. Recipient data included age, sex, and yearly serum creatinine levels. A retrospective study of out-of-hospital cardiac arrest cases treated by MDA during 2021 were analyzed to assess their compatibility as potential uDCDD donors. RESULTS: In total, 49 potential donors were referred to hospitals by MDA. Consent was obtained in 40 cases (83%), organ retrieval was performed in 28 cases, and 40 kidneys were transplanted from 21 donors (75% retrieval rate). At 1-year follow-up, 36 recipients had a functioning graft (4 returned to dialysis) and mean serum creatinine 1.59 ± 0.92 mg% (90% graft survival). Outcome after transplantation showed serum creatinine levels (mg%) at 2 years 1.41 ± 0.83, n=26; 3 years 1.48 ± 0.99, n=16; 4 years 1.07 ± 1.06, n=7; and 5 years 1.12 ± 0.31, n=5. One patient died of multiple myeloma at 3 years. The MDA audit revealed an unutilized pool of 125 potential cases, 90 of whom were transported to hospitals and 35 were declared dead at the scene. CONCLUSIONS: Transplant outcomes were encouraging, suggesting that more intensive implementation of the program may increase the number of kidneys transplanted, thus shortening recipient waiting lists.

**2.** Clin Transplant. 2023 Jul 8:e15058. doi: 10.1111/ctr.15058. Online ahead of print.
**Successful transplantation of LUCAS device assisted uncontrolled DCD kidneys with prolonged relative warm ischemia time: An underutilized option in North America.**
Nagaraju S(1), Savilla R(1), Moore M(1), Jones A(1), Africa J(1)(2).
**ABSTRACT**
Approximately 25% of deceased donors in the United States are procured in a donation after circulatory death (DCD) setting. Successful transplant outcomes from uncontrolled DCD (uDCD) practices have been reported in multiple European programs. They utilize established protocols for uDCD procurement with normo-thermic or hypothermic regional perfusion to reduce ischemic damage. Further, manual or mechanical chest compressions using extrinsic devices, such as the LUCAS device, are implemented to maintain circulation before organ retrieval. Currently, uDCDs are not a major part of DCD organ utilization in the United States. We report our experience with utilization of kidneys from uDCD with the use of the LUCAS device without normothermic or hypothermic regional perfusion. We transplanted four kidneys from three uDCD donors without utilization of in situ regional perfusion and with prolonged relative warm ischemia time (rWIT) (>100 min). All recipients had functional renal allografts and improved renal function after the transplant. To our knowledge, this is the 1st successful series reported in the United States of the

utilization of kidneys from uDCDs without the utilization of in situ perfusion to maintain organ preservation with prolonged rWIT.

**3.** J Pers Med. 2023 Jul 24;13(7):1177. doi: 10.3390/jpm13071177.
**Transesophageal Echocardiography Guidance to Prevent and Manage Pitfalls from Abdominal Normothermic Regional Perfusion and Optimize Timing during Organ Retrieval from a Donor after Circulatory Death.**
Bianchini A(1), Laici C(1), Miglionico N(2), Bianchi MG(2), Tarozzi E(2), Bernardi E(1), Toni J(1), Cordella E(3), Vitale G(4), Siniscalchi A(1).
**ABSTRACT**
An essential means of collecting more abdominal donor organs is controlled donation after circulatory death (cDCD). The organs are typically preserved during cDCD using the abdominal normothermic regional perfusion (A-NRP) technique to recirculate oxygenated blood flow following cardiac arrest and the withdrawal of life support. One of the challenges of A-NRP is ensuring the correct vascular devices' positionings, specifically extracorporeal membrane oxygenation cannulae and aortic balloons, typically achieved through fluoroscopy with or without contrast agents. Here, we present a case report in which transesophageal echocardiography (TEE) helped the transplant team to effectively procure viable abdominal organs from a cDCD donor in the shortest time frame, as minimizing time is one of the most crucial factors in maintaining organ viability. TEE use leads to a more effective and efficient A-NRP procedure with limited complications. In addition, it allows us to observe the circulation of both the thoracic and part of the abdominal organs using one fast exam. This case is the first report describing TEE as a primary guide and useful tool for DCD donors. However, prospective studies are needed to confirm that TEE could be used as standard practice during all DCD organ retrieval procedures.

**FEEDBACK**

**1.** Resusc Plus. 2023 Jun 23;15:100417. doi: 10.1016/j.resplu.2023.100417. eCollection 2023 Sep.
**Metronome use improves achievement of a target compression rate in out-of-hospital cardiac arrest: A retrospective analysis.**
Kennedy J(1), Machado K(2), Maynard C(3), Walker RG(4), Sayre MR(2)(5), Counts CR(2)(5).
**ABSTRACT**
AIM: The aim of this study was to evaluate chest compression rates (CCR) with and without the use of a metronome during treatment of out-of-hospital cardiac arrest (OHCA). METHODS: We performed a retrospective cohort investigation of non-traumatic OHCA cases treated by Seattle Fire Department from January 1, 2013, to December 31, 2019. The exposure was a metronome running during CPR at a rate of 110 beats per minute. The primary outcome was the median CCR for all periods of CPR with a metronome compared to periods without a metronome. RESULTS: We included 2,132 OHCA cases with 32,776 minutes of CPR data; 15,667 (48%) minutes had no metronome use, and 17,109 (52%) minutes had a metronome used. Without a metronome, the median CCR was 112.8 per minute with an interquartile range of 108.4 - 119.1, and 27% of minutes were above 120 or less than 100. With a metronome, the median CCR was 110.5 per minute with an interquartile range of 110.0-112.0, and less than 4% of minutes were above 120 or less than 100. The compression rate was 109, 110, or 111 in 62% of minutes with a metronome compared to 18% of minutes with no metronome. CONCLUSION: The use of a metronome during CPR resulted in increased compliance to a predetermined compression rate. Metronomes are a simple tool that improves achievement of a target compression rate with little variance from that target.

**DRUGS**

**1.** Pediatr Crit Care Med. 2023 Jul 13. doi: 10.1097/PCC.0000000000003323. Online ahead of print.
**Epinephrine Dosing Use During Extracorporeal Cardiopulmonary Resuscitation: Single-Center Retrospective Cohort.**
Kucher NM(1), Marquez AM(1), Guerguerian AM(1), Moga MA(1)(2), Vargas-Gutierrez M(1), Todd M(3), Honjo O(4), Haller C(4), Goco G(1), Floh AA(1)(2).

**ABSTRACT**
OBJECTIVES: During pediatric cardiac arrest, contemporary guidelines recommend dosing epinephrine at regular intervals, including in patients requiring extracorporeal membrane oxygenation (ECMO). The impact of epinephrine-induced vasoconstriction on systemic afterload and venoarterial ECMO support is not well-defined. DESIGN: Nested retrospective observational study within a single center. The primary exposure was time from last dose of epinephrine to initiation of ECMO flow; secondary exposures included cumulative epinephrine dose and arrest time. Systemic afterload was assessed by mean arterial pressure and use of systemic vasodilator therapy; ECMO pump flow and Vasoactive-Inotrope Score (VIS) were used as measures of ECMO support. Clearance of lactate was followed post-cannulation as a marker of systemic perfusion. SETTING: PICU and cardiac ICU in a quaternary-care center. PATIENTS: Patients 0-18 years old who required ECMO cannulation during resuscitation over the 6 years, 2014-2020. Patients were excluded if ECMO was initiated before cardiac arrest or if the resuscitation record was incomplete. INTERVENTIONS: None. MEASUREMENTS AND MAIN RESULTS: A total of 92 events in 87 patients, with 69 events having complete data for analysis. The median (interquartile range) of total epinephrine dosing was 65 mcg/kg (37-101 mcg/kg), with the last dose given 6 minutes (2-16 min) before the initiation of ECMO flows. Shorter interval between last epinephrine dose and ECMO initiation was associated with increased use of vasodilators within 6 hours of ECMO ($p = 0.05$), but not with mean arterial pressure after 1 hour of support (estimate, -0.34; $p = 0.06$). No other associations were identified between epinephrine delivery and mean arterial blood pressure, vasodilator use, pump speed, VIS, or lactate clearance. CONCLUSIONS: There is limited evidence to support the idea that regular dosing of epinephrine during cardiac arrest is associated with increased in afterload after ECMO cannulation. Additional studies are needed to validate findings against ECMO flows and clinically relevant outcomes.

**2.** Resusc Plus. 2023 Jul 14;15:100428. doi: 10.1016/j.resplu.2023.100428. eCollection 2023 Sep.
**Intravenous vs. intraosseous vascular access during out-of-hospital cardiac arrest - protocol for a randomised clinical trial.**
Meilandt C(1), Fink Vallentin M(1), Blumensaadt Winther K(1), Bach A(1), Dissing TH(1)(2), Christensen S(2)(3), Juhl Terkelsen C(4), Lass Klitgaard T(5), Mikkelsen S(6), Folke F(7)(8)(9), Granfeldt A(2)(3), Andersen LW(1)(2)(3)(10).

**ABSTRACT**
OBJECTIVE: During cardiac arrest, current guidelines recommend attempting intravenous access first and to consider intraosseous access if intravenous access is unsuccessful or impossible. However, these recommendations are only based on very low-certainty evidence. Therefore, the "Intravenous vs Intraosseous Vascular Access During Out-of-Hospital Cardiac Arrest" (IVIO) trial aims to determine whether there is a difference in patient outcomes depending on the type of vascular access attempted during out-of-hospital cardiac arrest. This current article describes the clinical IVIO trial. METHODS: The IVIO trial is an investigator-initiated, randomised trial of intravenous vs. intraosseous vascular access during adult non-traumatic out-of-hospital cardiac arrest in Denmark. The intervention will consist of minimum two attempts (if unsuccessful on the first attempt) to

successfully establish intravenous or intraosseous vascular access during cardiac arrest. The intraosseous group will be further randomised to the humeral or tibial site. The primary outcome is sustained return of spontaneous circulation and key secondary outcomes include survival and survival with a favourable neurological outcome at 30 days. A total of 1,470 patients will be included. RESULTS: The trial started in March 2022 and the last patient is anticipated to be included in the spring of 2024. The primary results will be reported after 90-day follow-up and are anticipated in mid-2024. CONCLUSION: The current article describes the design of the Danish IVIO trial. The findings of this trial will help inform future guidelines for selecting the optimal vascular access route during out-of-hospital cardiac arrest.

**3.** Clin Trials. 2023 Jul 24:17407745231188443. doi: 10.1177/17407745231188443. Online ahead of print.

**Randomized controlled dose-escalation design to evaluate the safety of a novel pharmacological cardiopulmonary resuscitation strategy.**

Benson S(1), Yannopoulos D(2), Aufderheide TP(3), Murray TA(1).

**ABSTRACT**

BACKGROUND/AIMS: The motivating randomized controlled phase I trial evaluates three sodium nitroprusside doses in a novel sodium nitroprusside-enhanced cardiopulmonary resuscitation strategy for improved end-organ perfusion relative to local standard of care. Sodium nitroprusside is a vasodilator with an established safety profile in other indications, whereas the local standard of care uses vasoconstrictors, typically epinephrine. The purpose of the proposed trial is to identify the highest safe dose of sodium nitroprusside in this new context as excessive doses may cause severe hypotension with compromised end-organ perfusion. METHODS: The proposed phase I trial design expands upon traditional dose-finding designs to include a randomized control arm, which is needed to assess safety through the relative increase in serum lactate on hospital admission. For guiding dose escalation, we propose and compare six Bayesian models which characterize expected serum lactate as a function of sodium nitroprusside dose and randomization group. Each model makes a different assumption about the expected change in serum lactate across control cohorts concurrently randomized with each dose. Model selection aims to minimize the expected number of times that a dose is incorrectly classified as safe or unsafe while sample size selection targets an expected number of incorrectly classified doses. Randomization is 1:1 for the initial cohort, and for subsequent cohorts is chosen to maximize the lower confidence bound. RESULTS: The spike-and-slab model minimizes the expected number of times that a dose is incorrectly classified as safe or unsafe under the most scenarios in the motivating three-dose trial, but all six models exhibit relatively similar performance. A 2:1 randomization ratio for the second and third cohorts maximizes the lower confidence bound when using the spike-and-slab model. With the optimal design, on average, 70 individuals will ensure 1 incorrectly classified dose in 6 opportunities. CONCLUSION: We recommend that the motivating trial use the spike-and-slab model with a 1:1 randomization ratio for the initial cohort and 2:1 randomization ratio for subsequent cohorts; however, the simpler fixed effects approaches performed similarly well.

**4.** Am Surg. 2023 Jun;89(6):2965-2968. doi: 10.1177/00031348221094213. Epub 2022 May 2.

**Cardiopulmonary Resuscitation and Epinephrine Use in Pediatric Traumatic Cardiac Arrest.**

Lelak KA(1), Arora R(1), Mowbray FI(2), Arkatkar Bs A(3), Krouse C(4), Cloutier D(4), Donoghue L(4)(5), Sethuraman U(1)(6).

**NO ABSTRACT AVAILABLE**

**TRAUMA**

**1.** J Trauma Acute Care Surg. 2023 Jun 29. doi: 10.1097/TA.0000000000004094. Online ahead of print.

**RESUSCITATIVE ENDOVASCULAR BALLOON OCCLUSION OF THE AORTA AND RESUSCITATIVE THORACOTOMY ARE ASSOCIATED WITH SIMILAR OUTCOMES IN TRAUMATIC CARDIAC ARREST.**

Koh EY(1), Fox EE(2), Wade CE(2), Scalea TM(3), Fox CJ(4), Moore EE(5), Morse BC(6), Inaba K(7), Bulger EM(8), Meyer DE.

**ABSTRACT**

BACKGROUND: Resuscitative endovascular balloon occlusion of the aorta (REBOA) is a minimally invasive alternative to resuscitative thoracotomy (RT) for patients with hemorrhagic shock. However, the potential benefits of this approach remain subject of debate. The aim of this study was to compare the outcomes of REBOA and RT for traumatic cardiac arrest. METHODS: A planned secondary analysis of the United States Department of Defense-funded Emergent Truncal Hemorrhage Control study was performed. Between 2017 and 2018, a prospective observational study of non-compressible torso hemorrhage was conducted at 6 Level 1 trauma centers. Patients were dichotomized by REBOA or RT, and baseline characteristics and outcomes were compared between groups. RESULTS: A total of 454 patients were enrolled in the primary study, of which 72 patients were included in the secondary analysis (26 underwent REBOA and 46 underwent resuscitative thoracotomy). REBOA patients were older, had a greater body mass index, and were less likely to be the victims of penetrating trauma. REBOA patients also had less severe abdominal injuries and more severe extremity injuries, though the overall injury severity scores were similar. There was no difference in mortality between groups (88% vs. 93%, p = 0.767). However, time to aortic occlusion was longer in REBOA patients (7 minutes vs. 4 minutes, p = 0.001) and they required more transfusions of red blood cells (4.5 units vs. 2.5 units, p = 0.007) and plasma (3 units vs. 1 unit, p = 0.032) in the emergency department. After adjusted analysis, mortality remained similar between groups (RR 0.89, 95% CI 0.71-1.12, p = 0.304). CONCLUSION: REBOA and RT were associated with similar survival after traumatic cardiac arrest, though time to successful AO was longer in the REBOA group. Further research is needed to better define the role of REBOA in trauma.

**2.** Arq Bras Cardiol. 2023 Jul 24;120(7):e20220551. doi: 10.36660/abc.20220551. eCollection 2023.

**Outcomes after Clinical and Traumatic Out-of-Hospital Cardiac Arrest.**

[Article in English, Portuguese; Abstract available in Portuguese from the publisher]

Nacer DT(1), Sousa RMC(1), Miranda AL(2).

**ABSTRACT**

BACKGROUND: Data on out-of-hospital cardiac arrest are still scarce, very varied, and indicate a poor prognosis for traumatic events. OBJECTIVES: To describe the out-of-hospital/in-hospital survival, survival time, and neurological conditions of those treated by advanced life support units and submitted to cardiopulmonary resuscitation and compare the results of clinical and traumatic cardiac arrests. METHODS: This is a cohort study carried out in three stages; in the first two, data were collected from the Mobile Emergency Care Service forms and medical records; then, the Brain Performance Category Scale was applied in the third stage. The sample consisted of resuscitated victims aged ≥18 years. Fisher's and log-rank tests were used to compare the causes, considering a significance level of 5%. RESULTS: 852 patients were analyzed; 20.66% were hospitalized, 4.23% survived until transfer or discharge, and 58.33% had a favorable outcome one year after arrest. There was an association between pre/in-hospital survival and the nature of the occurrence (p=0.026), but there was no difference between the survival curves (p=0.6). CONCLUSIONS: Survival of hospitalization after out-of-hospital cardiac arrest was low; however, most who survived to be discharged achieved a favorable outcome after one year. The survival time of those hospitalized

after clinical and traumatic events were similar, but pre-hospital survival was higher among trauma patients.

**VENTILATION**

**1.** Resuscitation. 2023 Jul;188:109812. doi: 10.1016/j.resuscitation.2023.109812. Epub 2023 Apr 28.
**A retrospective comparison of the King Laryngeal Tube and iGel supraglottic airway devices: A study for the CARES surveillance group.**
Smida T(1), Menegazzi J(2), Scheidler J(3), Martin PS(3), Salcido D(2), Bardes J(4); CARES Surveillance Group.
**ABSTRACT**
OBJECTIVE: Supraglottic airway devices are increasingly used during the resuscitation of out-of-hospital cardiac arrest (OHCA) patients in the United States and worldwide. In this study, we aimed to compare the neurologic outcomes of OHCA patients managed with the King Laryngeal Tube (King LT) to the neurologic outcomes of patients managed with the iGel. METHODS: We used the Cardiac Arrest Registry to Enhance Survival (CARES) public use research dataset for our analysis. Non-traumatic OHCA cases with attempted EMS resuscitation enrolled from 2013-2021 were included. We used two-level mixed effects multivariable logistic regression analyses with treating EMS agency as the random effect to determine the association between supraglottic airway device and outcome. The primary outcome was survival with a Cerebral Performance Category (CPC) score of 1 or 2 at discharge. Secondary outcomes included survival to hospital admission and survival to hospital discharge. Age, sex, calendar year of OHCA, initial ECG rhythm, witnessed status (unwitnessed, bystander witnessed, 9-1-1 responder witnessed), bystander CPR, response interval, and OHCA location (private/home, public, institutional) were used as covariables. RESULTS: In comparison to use of the King LT, use of the iGel was associated with greater neurologically favorable survival (aOR: 1.45 [1.33, 1.58]). In addition, use of the iGel was associated with greater survival to hospital admission (1.07 [1.02, 1.12]) and survival to hospital discharge (1.35 [1.26, 1.46]). CONCLUSIONS: This study adds to the body of literature suggesting that use of the iGel during OHCA resuscitation is associated with better outcomes than use of the King LT.

**2.** Resusc Plus. 2023 Jul 7;15:100422. doi: 10.1016/j.resplu.2023.100422. eCollection 2023 Sep.
**Pre-hospital airway management and neurological status of patients with out-of-hospital cardiac arrest: A retrospective cohort study.**
Hatakeyama T(1), Kiguchi T(2)(3), Sera T(4)(5), Nachi S(6)(7), Urushibata N(5), Ochiai K(5), Kitamura T(8), Ogura S(6), Otomo Y(9), Iwami T(2).
**ABSTRACT**
PURPOSE: Little is known about whether pre-hospital advanced airway management (AAM) under the presence of a physician could improve outcome of patients with cardiac arrest, compared with pre-hospital AAM under the absence of a physician. METHODS: This retrospective multicentre-cohort study enrolled consecutive patients who were transported to participating hospitals after out-of-hospital cardiac arrest in Japan between 1 June 2014 and 31 December 2019. We included patients who underwent pre-hospital AAM and resuscitation after arrival at hospital, and who were ≥18 years of age, with medical aetiologies. The primary outcome was favourable neurological survival (Cerebral Performance Category score of 1 or 2) one month after cardiac arrest. The primary outcome was called one-month favourable neurological survival. The first confirmed cardiac rhythm was defined using 3-lead electrocardiogram monitor or an automated external defibrillator and by determining whether the carotid artery was pulsating. Previous research found that the presence of a pre-hospital physician was associated with improved patients' outcomes, after the type of first confirmed cardiac rhythm was considered. Therefore, the first confirmed cardiac rhythm in current study was subdivided into non-shockable or shockable groups. A multivariable logistic regression analysis was performed on propensity score-matched patients. RESULTS: We analysed

16,703 patients. Among the 2,346 patients in the non-shockable group, 1.2% (N = 29) achieved the primary outcome. The adjusted odds ratio of pre-hospital AAM with or without a physician for the primary outcome in the results of the non-shockable group was 4.64 (95% confidence interval: 1.81-14.4). Among the 826 patients in the shockable group, 16.9% (N = 140) achieved the primary outcome and the adjusted odds ratio of pre-hospital AAM with or without a physician for the primary outcome in the results of the shockable group was 1.05 (95% confidence interval: 0.67-1.63). CONCLUSIONS: This retrospective multicentre-cohort study found that pre-hospital AAM under the presence of a physician was significantly associated with increased neurological outcome in specific patients with cardiac arrest, compared with pre-hospital AAM under the absence of a physician.

**3.** Int J Cardiol Heart Vasc. 2023 Jul 5;47:101243. doi: 10.1016/j.ijcha.2023.101243. eCollection 2023 Aug.
**Oxygen targets following cardiac arrest: A meta-analysis of randomized controlled trials.**
Cheema HA(1), Shafiee A(2)(3), Akhondi A(3), Seighali N(3), Shahid A(1), Rehman MEU(4), Almas T(5), Hadeed S(6), Nashwan AJ(7), Ahmad S(8).
**ABSTRACT**
INTRODUCTION: The appropriate oxygen target post-resuscitation in out-of-hospital cardiac arrest (OHCA) patients is uncertain. We sought to compare lower versus higher oxygen targets in patients following OHCA. METHODS: We searched MEDLINE, Embase, the Cochrane Library, and ClinicalTrials.gov until January 2023 to include all randomized controlled trials (RCTs) that evaluated conservative vs. liberal oxygen therapy in OHCA patients. Our primary outcome was all-cause mortality at 90 days while our secondary outcomes were the level of neuron-specific enolase (NSE) at 48 h, ICU length of stay (LOS), and favorable neurological outcome (the proportion of patients with Cerebral Performance Category scores of 1-2 at end of follow-up). We used RevMan 5.4 to pool risk ratios (RRs) and mean differences (MDs). RESULTS: Nine trials with 1971 patients were included in our review. There was no significant difference between the conservative and liberal oxygen target groups regarding the rate of all-cause mortality (RR 0.95, 95% CI: 0.80 to 1.13; I2 = 55%). There were no significant differences between the two groups when assessing favorable neurological outcome (RR 1.01, 95% CI: 0.92 to 1.10; I2 = 4%), NSE at 48 h (MD 0.04, 95% CI: -0.67 to 0.76; I2 = 0%), and ICU length of stay (MD -2.86 days, 95% CI: -8.00 to 2.29 days; I2 = 0%). CONCLUSIONS: Conservative oxygen therapy did not decrease mortality, improve neurologic recovery, or decrease ICU LOS as compared to a liberal oxygen regimen. Future large-scale RCTs comparing homogenous oxygen targets are needed to confirm these findings.

## CEREBRAL MONITORING

**1.** Resuscitation. 2023 Jul;188:109790. doi: 10.1016/j.resuscitation.2023.109790. Epub 2023 Apr 5.
**Delayed neurologic improvement and long-term survival of patients with poor neurologic status after out-of-hospital cardiac arrest: A retrospective cohort study in Japan.**
Hayamizu M(1), Kodate A(2), Sageshima H(2), Tsuchida T(3), Honma Y(1), Mizugaki A(1), Yoshida T(1), Saito T(1), Katabami K(1), Wada T(1), Maekawa K(1), Hayakawa M(4).
**ABSTRACT**
AIM: To assess survival duration and frequency of delayed neurologic improvement in patients with poor neurologic status at discharge from emergency hospitals after out-of-hospital cardiac arrest (OHCA). METHODS: This retrospective cohort study included OHCA patients admitted to two tertiary emergency hospitals in Japan between January 2014 and December 2020. Pre-hospital, tertiary emergency hospital, and post-acute care hospital data, were retrospectively collected by reviewing medical records. Neurologic improvements were defined as an improvement of Cerebral Performance Category (CPC) scores from 3 or 4 at hospital discharge to 1 or 2. The primary outcome

was neurologic improvement after discharge, while the secondary outcome was survival time after cardiac arrest. RESULTS: Of all patients (n = 1,012) admitted to tertiary emergency hospitals after OHCA during the observation period, 239 with CPC 3 or 4 at discharge were included, and all were Japanese. Median age was 75 years, 64% were male, and 31% had initially shockable rhythms. Neurologic improvements were observed in nine patients (3.6%), higher in CPC 3 (31%) than CPC 4 (1.3%) patients, but not after 6 months from cardiac arrest. The median survival time after cardiac arrest was 386 days (95% confidence interval: 303-469). CONCLUSION: Survival probability in patients with CPC 3 or 4 was 50% at 1-year and 20% at 3-year. Neurologic improvements were observed in 3.6% patients, higher in CPC 3 than in CPC 4 patients. During the first 6 months after OHCA, the neurologic status may improve in patients with CPC 3 or 4.

**2.** Ann Emerg Med. 2023 Jul;82(1):84-93. doi: 10.1016/j.annemergmed.2023.02.009. Epub 2023 Mar 23.

**Frailty and Neurologic Outcomes of Patients Resuscitated From Nontraumatic Out-of-Hospital Cardiac Arrest: A Prospective Observational Study.**

Yamamoto R(1), Tamura T(2), Haiden A(2), Yoshizawa J(2), Homma K(2), Kitamura N(3), Sugiyama K(4), Tagami T(5), Yasunaga H(6), Aso S(7), Takeda M(8), Sasaki J(2); SOS-KANTO 2017 Study Group.

**ABSTRACT**

STUDY OBJECTIVE: To elucidate the clinical utility of the Clinical Frailty Scale score for predicting poor neurologic functions in patients resuscitated from out-of-hospital cardiac arrest (OHCA). METHODS: This was a prospective, multicenter, observational study conducted between 2019 and 2021. The study included adults with nontraumatic OHCA admitted to the intensive care unit after return of spontaneous circulation (ROSC). Pre-arrest high Clinical Frailty Scale score was defined as 5 or more. Favorable neurologic outcomes defined as a Cerebral Performance Category score of 2 or less at 30 days after admission were compared between patients with and without high Clinical Frailty Scale scores. Multivariable logistic regression analyses fitted with generalized estimating equations were performed to adjust for patient characteristics, out-of-hospital information, and resuscitation content and account for within-institution clustering. RESULTS: Of 9,909 patients with OHCA during the study period, 1,216 were included, and 317 had a pre-arrest high Clinical Frailty Scale score. Favorable neurologic outcomes were fewer among patients with high Clinical Frailty Scale scores. The high Clinical Frailty Scale score group showed a lower percentage of favorable neurologic outcomes after OHCA than the low Clinical Frailty Scale score group (6.1% vs 24.4%; adjusted odds ratio, 0.45 [95% confidence interval 0.22 to 0.93]). This relationship remained in subgroups with cardiogenic OHCA, with ROSC after hospital arrival, and without a high risk of dying (Clinical Frailty Scale score of 7 or less), whereas the neurologic outcomes were comparable regardless of pre-arrest frailty in those with noncardiogenic OHCA and with ROSC before hospital arrival. CONCLUSIONS: Pre-arrest high Clinical Frailty Scale score was associated with unfavorable neurologic functions among patients resuscitated from OHCA. The Clinical Frailty Scale score would help predict clinical consequences following intensive care after ROSC.

**3.** Neurology. 2023 Jul 6:10.1212/WNL.0000000000207537. doi: 10.1212/ WNL. 0000000000207537.Online ahead of print.

**Neurophysiology State Dynamics Underlying Acute Neurological Recovery After Cardiac Arrest.**

Amorim E(1)(2), Zheng WL(2)(3), Jing J(2)(4), Ghassemi MM(5), Lee JW(6), Wu O(7), Herman ST(8), Pang T(4), Sivaraju A(9), Gaspard N(9)(10), Hirsch L(9), Ruijter BJ(11), Tjepkema-Cloostermans MC(11), Hofmeijer J(11)(12), van Putten MJAM(11)(13), Westover MB(2)(4).

**ABSTRACT**

BACKGROUND AND OBJECTIVES: Epileptiform activity and burst suppression are neurophysiology signatures reflective of severe brain injury following cardiac arrest. We aimed to delineate the evolution of coma neurophysiology features ensembles associated with recovery from coma after cardiac arrest. METHODS: Adult subjects in acute coma following cardiac arrest were included in a retrospective database involving seven hospitals. The combination of three quantitative EEG features (burst suppression ratio [BSup], spike frequency [SpF], and Shannon's entropy [En]) was used to define five distinct neurophysiology states: Epileptiform High Entropy (EHE: SpF ≥4/minute and En ≥5); Epileptiform and Low Entropy (ELE: SpF ≥4/minute and <5 En); Non-Epileptiform High Entropy (NEHE: SpF <4/minute and ≥5 En); Non-Epileptiform Low Entropy (NELE: SpF<4/minute and <5 En), and Burst Suppression (BSup≥50% and SpF <4/minute). State transitions were measured at consecutive 6h blocks between 6-84h after return of spontaneous circulation. Good neurological outcome was defined as best Cerebral Performance Category (CPC) 1-2 at 3-6 months. RESULTS: One-thousand thirty-eight subjects were included (50,224 hours of EEG), and 373 (36%) had good outcome. Subjects with EHE state had a 29% rate of good outcome while those with ELE had 11%. Transitions out of an EHE or BSup to a NEHE were associated with good outcome (45% and 20%, respectively). No subjects with ELE state lasting >15h had good recovery. DISCUSSION: Transition to high entropy states is associated with increased likelihood of good outcome despite preceding epileptiform or burst suppression states. High entropy may reflect mechanisms of resilience to hypoxic-ischemic brain injury.

**ULTRASOUND AND CPR**

**1.** Prehosp Disaster Med. 2023 Jul 17:1-6. doi: 10.1017/S1049023X23006003. Online ahead of print.
**Impact of Point-of-Care Ultrasound on Prehospital Decision Making by HEMS Physicians in Critically Ill and Injured Patients: A Prospective Cohort Study.**
Vianen NJ(1), Van Lieshout EMM(1), Vlasveld KHA(1), Maissan IM(2), Gerritsen PC(3), Den Hartog D(1), Verhofstad MHJ(1), Van Vledder MG(1).

**ABSTRACT**

INTRODUCTION: Several studies have shown the additional benefit of point-of-care ultrasound (POCUS) by prehospital Emergency Medical Services (EMS). Since organization of EMS may vary significantly across countries, the value of POCUS likely depends on the prehospital system in which it is used. In order to be able to optimally implement POCUS and develop a tailored training curriculum, it is important to know how often POCUS is currently used, for which indications it is used, and how it affects decision making. The aims of this study were: (1) to determine the percentage of patients in whom POCUS was used by Dutch Helicopter Emergency Medical Services (HEMS) crews; (2) to determine how often POCUS findings led to changes in on-scene management; and (3) what these changes were. METHODS: Patients who received prehospital care from December 1, 2020 through March 31, 2021 by a single HEMS crew were included in this prospective cohort study. Clinical data and specific data on POCUS examination, findings, and therapeutic consequences were collected and analyzed. RESULTS: During the study period, on-scene HEMS care was provided to 612 patients, of which 211 (34.5%) patients underwent POCUS. Of these, 209 (34.2%) patients with a median age of 45 years were included. There were 131 (62.7%) trauma patients, and 70 (33.7%) of the included patients underwent cardiopulmonary resuscitation (CPR). The median reported time of POCUS examination was three (P25-P75 2-5) minutes. Median prolongation of on-scene time was zero (P25-P75 0-1) minutes. In 85 (40.7%) patients, POCUS examination had therapeutic consequence: POCUS was found to impact treatment decisions in 34 (26.0%) trauma patients and 51 (65.4%) non-trauma patients. In patients with cardiac arrest, POCUS was most often used to aid decision making with regard to terminating or continuing resuscitation

(28 patients; 13.4%). CONCLUSION: During the study period, POCUS examination was used in 34.5% of all prehospital HEMS patients and had a therapeutic consequence in 40.7% of patients. In trauma patients, POCUS seems to be most effective for patient triage and evaluation of treatment effectiveness. Moreover, POCUS can be of significant value in patients undergoing CPR. A tailored HEMS POCUS training curriculum should include ultrasound techniques for trauma and cardiac arrest.

## ORGANISATION AND TRAINING

**1.** Resusc Plus. 2023 Jun 16;15:100415. doi: 10.1016/j.resplu.2023.100415. eCollection 2023 Sep.
**Resuscitation team training in Rwanda: A mixed method study exploring the combination of the VAST course with Advanced Cardiac Life Support training.**
Tuyishime E(1)(2)(3), Mossenson A(4)(5)(6), Livingston P(5), Irakoze A(1), Seneza C(7), Ndekezi JK(8), Skelton T(9).

**ABSTRACT**

INTRODUCTION: The influence of non-technical skills training on resuscitation performance in low-resource settings is unknown. This study investigates combining the Vital Anaesthesia Simulation Training Course with Advanced Cardiac Life Support training on resuscitation performance in Rwanda. METHODS: Participants in this mixed method study are members of resuscitation teams in three district hospitals in Rwanda. The intervention was participation in a 2-day Advanced Cardiac Life Support course followed by the 3-day Vital Anaesthesia Simulation Training Course. Quantitative primary endpoints were time to initiation of cardiopulmonary resuscitation, time to epinephrine administration, and time to defibrillation. Qualitative data on workplace implementation were gathered during focus groups held 3-months post-intervention. RESULTS: Forty-seven participants were recruited. Quantitative data showed a statistically significant decrease in time to cardiopulmonary resuscitation, epinephrine administration, and defibrillation from pre- to post-Advanced Cardiac Life Support, with times of [43.3 (49.7) seconds] versus [16.5 (20) sec], $p = <0.001$; [137.3 (108.9) sec] versus [51.3 (37.9)], $p = <0.001$; and [218.5 (105.8) sec] versus [110.8 (87.1) sec], $p = <0.001$; respectively. These improvements were maintained following the Vital Anaesthesia Simulation Training Course, and at 3-month retention testing. Qualitative analysis highlighted five key themes: ability to initiate cardiopulmonary resuscitation; team coordination for task allocation; empowerment; desire for training and mentorship; and advocacy for system improvement. CONCLUSION: A modified 2-day Advanced Cardiac Life Support course improved resuscitation time indicators with retention 3-months later. Combining the Vital Anaesthesia Simulation Training Course and Advanced Cardiac Life Support led to better team coordination, empowerment to act, and advocacy for system improvement. This pairing of courses has promise for improving Advanced Cardiac Life Support skills amongst healthcare workers in low-resource settings.

**2.** Heart Lung. 2023 Jun 26;62:101-107. doi: 10.1016/j.hrtlng.2023.06.020. Online ahead of print.
**Health professionals and family members during cardiopulmonary resuscitation: A qualitative study on the experience of witnessing resuscitation in Jordanian critical care units.**
Saifan AR(1), Elshatarat RA(2), Saleh ZT(3), Elhefnawy KA(4), Elneblawi NH(2), Al-Sayaghi KM(5), Masa'Deh R(1), Al-Yateem N(6), Abdel-Aziz HR(7), Saleh AM(8).

**ABSTRACT**

BACKGROUND: The interaction between healthcare professionals (HCPs) and family members during cardiopulmonary resuscitation (CPR) in critical care units (CCUs) has received significant attention. In the Arabic region, family members are typically excluded from participating in critical care treatments, despite the cultural and religious significance of their presence. This highlights a lack of

policies and research addressing the cultural factors related to family involvement in CPR within this context. OBJECTIVES: The purpose of this study was to explore the nature of the relationship between HCPs and family member relations during CPR in Jordanian CCUs. METHODS: This study employed a qualitative research design. Data were collected through semi-structured interviews with 45 participants, including 31 HCPs and 14 family members of patients who had undergone CPR in Jordan. Data was managed, organized, and thematically analyzed using NVivo. RESULTS: The study revealed three main themes: Family-Witnessed Resuscitation (FWR) through the eyes of HCPs, FWR through the eyes of family members, and the relationship between HCPs and family members during CPR. The last theme has three subthemes: "Looking out for the Patient," "Looking out for Ourselves," and "Looking out for Each Other." These themes highlighted the complex and dynamic relationships between HCPs and family members during CPR in Jordan. Participants emphasized the importance of clear communication, mutual respect, and a collaborative approach to decision-making during CPR. CONCLUSION: The resultant study model uniquely explains the relationship between Jordanian health professionals and family members during CPR, with important implications for clinical practice and healthcare policies regarding family involvement during resuscitation in Jordan. Further research is needed to explore the cultural and societal factors influencing family involvement in resuscitation in Jordan and other Arab countries.

**3.** BMC Nurs. 2023 Jun 27;22(1):220. doi: 10.1186/s12912-023-01388-5.
**Perceptions of nurses regarding quality of adult cardiopulmonary resuscitation in Ghana: a qualitative study.**
Amoako-Mensah E(1), Achempim-Ansong G(2), Gbordzoe NI(2), Adofo CE(1), Sarfo JO(3).
**ABSTRACT**
OBJECTIVES: Cardiopulmonary resuscitation (CPR) is a necessary life-saving emergency intervention for patients with cardiac arrest and other medical conditions. The study's primary objective was to qualitatively explore nurses' perceptions of the quality of adult cardiopulmonary resuscitation in Ghana. METHODS: An exploratory descriptive qualitative study was conducted among 13 purposively sampled nurses in Ghana. We collected thirteen face-to-face and telephone interviews using a semi-structured interview guide. Data were transcribed verbatim and analysed using the thematic analysis approach recommended by Braun and Clarke. RESULTS: Data analysis revealed that nurses were filled with positive emotions when patients regained consciousness following resuscitation. When the otherwise happens, they tend to become tortured psychologically and filled with negative emotions. Besides, environmental factors such as the time of initiating CPR following a cardiac arrest, the availability and appropriateness of equipment and medications, workplace ergonomics, and institutional regulations affected the quality of resuscitation practices of nurses. Participants perceived that attitudes of condemnation, prejudice, apathy and skills deficiency also impacted the quality of resuscitation practices. Significant aspects of self-reported behavioural competence that affected resuscitation were knowledge and skills of CPR, confidence in initiating CPR, and the need for effort maximisation. CONCLUSION: This study revealed several non-medical factors that influenced the resuscitation practices of nurses from their perspective. Nurses need to maximise their effort toward seeking further education in speciality areas such as emergency nursing and critical care nursing to guide their CPR practices and other newly emerging evidence-based protocols.

**4.** R I Med J (2013). 2023 Jul 5;106(6):47-50.
**'Cardiac Arrest' - The CPR Song.**
Dhillon SA(1), Shahab A(1), Bashir Z(1).
**NO ABSTRACT AVAILABLE**

**5.** Resusc Plus. 2023 Jun 15;15:100407. doi: 10.1016/j.resplu.2023.100407. eCollection 2023 Sep.
**Facilitating cardiopulmonary resuscitation training in high-risk areas of England: A study protocol.**
Hawkes CA(1), Staniszewska S(2), Vlaev I(3), Perkins GD(2)(4), Howe D(5), Khalifa E(6), Mustafa Y(6), Parsons N(2), Lin YL(2), Rycroft-Malone J(7).

**ABSTRACT**
INTRODUCTION: Bystanders' interventions improve chances of survival from out-of-hospital cardiac arrest (OHCA) before Emergency Medical Services arrive. Some areas in England are of concern. These high-risk areas have a higher incidence of cardiac arrest combined with lower-than-average bystander CPR rates and are characterised by higher proportions of minority ethnic group residents and deprivation.Collaborating with people from the Black African and Caribbean and South Asian minority communities in deprived areas of England, we aim to develop and evaluate the implementation of theoretically informed intervention(s) to address factors contributing to lower bystander intervention rates. METHODS: The study is a collaborative realist enquiry, informed by the Theoretical Domains Framework and associated Behaviour Change Wheel. It consists of 1) a realist evidence synthesis to produce initial program theories developed from primary workshop data and published evidence. It will include identifying factors contributing to the issue and potential interventions to address them; 2) theoretically informed intervention development, using the initial program theories and behaviour change theory and 3) a realist mixed methods implementation evaluation with embedded feasibility. Public involvement (PPI) as study team and public advisory group members is key to this study.We will conduct realist evidence synthesis, qualitative and statistical analyses appropriate to the various methods used. DISSEMINATION: We will develop a dissemination plan and materials targeted to members of the public in high-risk areas as well as academic outputs. We will hold an event for participating community groups and stakeholders to share findings and seek advice on next steps. STUDY REGISTRATION: ISRCTN90350842. Registration date 28.03.2023. The study was registered after its start date.

**6.** Resuscitation. 2023 Jul;188:109818. doi: 10.1016/j.resuscitation.2023.109818. Epub 2023 May 5.
**Quantifying physician's bias to terminate resuscitation. The TERMINATOR study.**
Laurenceau T(1), Marcou Q(2), Agostinucci JM(3), Martineau L(4), Metzger J(5), Nadiras P(6), Michel J(7), Petrovic T(8), Adnet F(9), Lapostolle F(10).

**ABSTRACT**
CONTEXT: Deciding on "termination of resuscitation" (TOR) is a dilemma for any physician facing cardiac arrest. Due to the lack of evidence-based criteria and scarcity of the existing guidelines, crucial arbitration to interrupt resuscitation remains at the practitioner's discretion. AIM: Evaluate with a quantitative method the existence of a physician internal bias to terminate resuscitation. METHOD: We extracted data concerning OHCAs managed between January 2013 and September 2021 from the RéAC registry. We conducted a statistical analysis using generalized linear mixed models to model the binary TOR decision. Utstein data were used as fixed effect terms and a random effect term to model physicians personal bias towards TOR. RESULTS: 5,144 OHCAs involving 173 physicians were included. The cohort's average age was 69 (SD 18) and was composed of 62% of women. Median no-flow and low-flow times were respectively 6 (IQR [0,12]) and 18 (IQR [10,26]) minutes. Our analysis showed a significant ($p < 0.001$) physician effect on TOR decision. Odds ratio for the "doctor effect" was 2.48 [2.13-2.94] for a doctor one SD above the mean, lower than that of dependency for activities of daily living (41.18 [24.69-65.50]), an age of more than 85 years (38.60 [28.67-51.08]), but higher than that of oncologic, cardiovascular, respiratory disease or no-flow duration between 10 to 20 minutes (1.60 [1.26-2.00]). CONCLUSIONS: We demonstrate the existence of individual physician biases in their decision about TOR. The impact of this bias is greater

than that of a no-flow duration lasting ten to twenty minutes. Our results plead in favor developing tools and guidelines to guide physicians in their decision.

**7.** Curr Probl Cardiol. 2023 Jun 30;48(11):101915. doi: 10.1016/j.cpcardiol.2023.101915. Online ahead of print.
**AI-Enabled Public Surveillance Cameras for Rapid Emergency Medical Service Activation in Out-of-Hospital Cardiac Arrests.**
Darginavicius L(1), Vencloviene J(2), Dobozinskas P(3), Vaitkaitiene E(4), Vaitkaitis D(3), Pranskunas A(5), Krikscionaitiene A(3).
**ABSTRACT**
This study aims to evaluate the potential usefulness of a novel artificial intelligence (AI)-based video processing algorithm for rapidly activating ambulance services (EMS) in unwitnessed out-of-hospital cardiac arrest (OHCA) cases in public places. We hypothesized that AI should activate EMS using public surveillance cameras after detecting a person fallen due to OHCA. We created an AI model based on our experiment performed at the Lithuanian University of Health Sciences, Kaunas, Lithuania, in Spring 2023. Our research highlights the potential benefits of AI-based surveillance cameras for rapidly detecting and activating EMS during cardiac arrests.

**8.** Am J Emerg Med. 2023 Jun 28;71:163-168. doi: 10.1016/j.ajem.2023.06.035. Online ahead of print.
**Dispatcher-assisted BLS for lay bystanders: A pilot study comparing video streaming via smart glasses and telephone instructions.**
Aranda-García S(1), Barrio-Cortes J(2), Fernández-Méndez F(3), Otero-Agra M(4), Darné M(5), Herrera-Pedroviejo E(6), Barcala-Furelos R(7), Rodríguez-Núñez A(8).
**ABSTRACT**
OBJECTIVE: To determine whether dispatcher assistance via smart glasses improves bystander basic life support (BLS) performance compared with standard telephone assistance in a simulated out-of-hospital cardiac arrest (OHCA) scenario. METHODS: Pilot study in which 28 lay people randomly assigned to a smart glasses-video assistance (SG-VA) intervention group or a smartphone-audio assistance (SP-AA) control group received dispatcher guidance from a dispatcher to provide BLS in an OHCA simulation. SG-VA rescuers received assistance via a video call with smart glasses (Vuzix, Blade) connected to a wireless network, while SP-AA rescuers received instructions over a smartphone with the speaker function activated. BLS protocol steps, quality of chest compressions, and performance times were compared. RESULTS: Nine of the 14 SG-VA rescuers correctly completed the BLS protocol compared with none of the SP-AA rescuers ($p = 0.01$). A significantly higher number of SG-VA rescuers successfully opened the airway (13 vs. 5, $p = 0.002$), checked breathing (13 vs. 8, $p = 0.03$), correctly positioned the automatic external defibrillator pads (14 vs.6, $p = 0.001$), and warned bystanders to stay clear before delivering the shock (12 vs. 0, $p < 0.001$). No significant differences were observed for performance times or chest compression quality. The mean compression rate was 104 compressions per minute in the SG-VA group and 98 compressions per minute in the SP-AA group ($p = 0.46$); mean depth of compression was 4.5 cm and 4.4 cm ($p = 0.49$), respectively. CONCLUSIONS: Smart glasses could significantly improve dispatcher-assisted bystander performance in an OHCA event. Their potential in real-life situations should be evaluated.

**9.** Resuscitation. 2023 Jul 4:109894. doi: 10.1016/j.resuscitation.2023.109894. Online ahead of print.
**Interpretable machine learning model for imaging-based outcome prediction after cardiac arrest.**
Liu C(1), Elmer J(2), Arefan D(3), Pease M(4), Wu S(5).
**ABSTRACT**

INTRODUCTION: Early identification of brain injury patterns in computerized tomography (CT) imaging is crucial for post-cardiac arrest prognostication. Lack of interpretability of machine learning prediction reduces trustworthiness by clinicians and prevents translation to clinical practice. We aimed to identify CT imaging patterns associated with prognosis with interpretable machine learning. METHODS: In this IRB-approved retrospective study, we included consecutive comatose adult patients hospitalized at a single academic medical center after resuscitation from in- and out-of-hospital cardiac arrest between August 2011 and August 2019 who underwent unenhanced CT imaging of the brain within 24 hours of their arrest. We decomposed the CT images into subspaces to identify interpretable and informative patterns of injury, and developed machine learning models to predict patient outcomes (i.e., survival and awakening status) using the identified imaging patterns. Practicing physicians visually examined the imaging patterns to assess clinical relevance. We evaluated machine learning models using 80%-20% random data split and reported AUC values to measure the model performance. RESULTS: We included 1284 subjects of whom 35% awakened from coma and 34% survived hospital discharge. Our expert physicians were able to visualize decomposed image patterns and identify those believed to be clinically relevant on multiple brain locations. For machine learning models, the AUC was 0.710 ± 0.012 for predicting survival and 0.702 ± 0.053 for predicting awakening, respectively. DISCUSSION: We developed an interpretable method to identify patterns of early post-cardiac arrest brain injury on CT imaging and showed these imaging patterns are predictive of patient outcomes (i.e., survival and awakening status).

**10.** BMC Med Educ. 2023 Jul 5;23(1):496. doi: 10.1186/s12909-023-04476-x.

**A six-year teaching life supportive first aid program to eventually generate peer trainer pupils: a prospective case control study.**

von Amelunxen B(1), Kirk S(1), Hind J(1), Illibauer J(1), Krall C(2), Lessing S(3), Noyelle A(3), Murphy PMJ(3), Sterz F(4)(5).

**ABSTRACT**

BACKGROUND: Out of hospital cardiac arrest is a life-threatening condition. To improve the chances of survival, lay-person cardio-pulmonary-resuscitation (CPR) is a crucial factor. Many bystanders fail to react appropriately, even if life supporting first aid (LSFA) programs and campaigns including CPR tried to increase the handling of basic cardiac life support. To achieve an enhanced learning of CPR a pupil's grade after grade teaching program was established in a school with medical students. METHODS: The learning of CPR was investigated in a prospective, case-controlled study at an international school. Pupils (12 ± 3 years old) joining our LSFA courses (n = 538, female: 243, attendance for evaluation: 476) were compared to a control group (n = 129, female: 52, attendance for evaluation: 102). Surveys and quality of CPR (QCPR%) through a computer linked "Resusci Anne" dummy were compared with Chi-squared tests, t-tests pair wisely, and by one-way ANOVA. RESULTS: Knowledge and skills on the "Resusci Anne" were significantly better in trained grade 9 pupils compared to the control group (QCPR, 59 vs. 25%). The number of LSFA courses each grade 9 student had, correlated with improved practical performance ($r2 = 0.21$, $p < 0.001$). The willingness to deliver CPR to strangers increased with improved practical performance. Attitudes towards performing CPR were high in all participating grades. CONCLUSION: Repetitive teaching LSFA to grade 5-9 pupil's grade after grade by medical students has been successfully established. Pupils who finish the program will eventually be able to teach LSFA to younger students. This is furthermore a good way of sharing a "learning by teaching" role and it enables to have more pupils as trainers who can provide instruction to a larger number of pupils with the purpose of having a better-trained population in LSFA.

**11.** Resuscitation. 2023 Aug;189:109893. doi: 10.1016/j.resuscitation.2023.109893. Epub 2023 Jul 3.

**Enhancing Cardiac Arrest Education: Exploring the potential use of MidJourney.**
Alberto Mazzoli C(1), Semeraro F(2), Gamberini L(1).
**NO ABSTRACT AVAILABLE**

**12.** J Am Coll Cardiol. 2023 Jul 18;82(3):200-210. doi: 10.1016/j.jacc.2023.05.017.
**Dispatch of Volunteer Responders to Out-of-Hospital Cardiac Arrests.**
Jonsson M(1), Berglund E(2), Baldi E(3), Caputo ML(4), Auricchio A(4), Blom MT(5), Tan HL(6), Stieglis R(6), Andelius L(7), Folke F(8), Hollenberg J(2), Svensson L(9), Ringh M(2); ESCAPE-NET Investigators.
**ABSTRACT**
BACKGROUND: Systems for dispatch of volunteer responders to collect automated external defibrillators and/or to provide cardiopulmonary resuscitation (CPR) in cases of nearby out-of-hospital cardiac arrest (OHCA) are widely implemented. OBJECTIVES: This study aimed to investigate whether the activation of a volunteer responder system to OHCAs was associated with higher rates of bystander CPR, bystander defibrillation, and 30-day survival vs no system activation. METHODS: This was a retrospective observational analysis within the ESCAPE-NET (European Sudden Cardiac Arrest network: Towards Prevention, Education, New Effective Treatment) collaborative research network. Included were cases of OHCA between 2015 and 2019 from 5 European sites with volunteer responder systems. At all sites, systems were activated by dispatchers at the emergency medical communication center in response to suspected OHCA. Exposed cases (system activation) were compared with nonexposed cases (no system activation). Risk ratios (RRs) were calculated for the outcomes of bystander CPR, bystander defibrillation, and 30-day survival after inverse probability treatment weighting. Missing data were handled using multiple imputation. RESULTS: In total, 9,553 cases were included. In 4,696 cases, the volunteer responder system was activated, and in 4,857 it was not. The pooled RRs were 1.30 (95% CI: 1.15-1.47) for bystander CPR, 1.89 (95% CI: 1.36-2.63) for bystander defibrillation, and 1.22 (95% CI: 1.07-1.39) for 30-day survival. CONCLUSIONS: Activation of a volunteer response system in cases of OHCA was associated with a higher chance of bystander CPR, bystander defibrillation, and 30-day survival vs no system activation. A randomized controlled trial is necessary to determine fully the causal effect of volunteer responder systems.

**13.** JMIR Public Health Surveill. 2023 Jul 11;9:e47156. doi: 10.2196/47156.
**Association of Socioeconomic Status With Long-Term Outcome in Survivors After Out-of-Hospital Cardiac Arrest: Nationwide Population-Based Longitudinal Study.**
Yoo KH(#)(1), Cho Y(#)(1)(2), Oh J(1)(2), Lee J(1)(2), Ko BS(1)(2), Kang H(1)(2), Lim TH(1)(2), Lee SH(1).
**ABSTRACT**
BACKGROUND: Out-of-hospital cardiac arrest (OHCA) is a major public health problem and a leading cause of death worldwide. Previous studies have focused on improving the survival of people who have had OHCA by analyzing short-term survival outcomes, such as the return of spontaneous circulation, 30-day survival, and survival to discharge. Research has been conducted on prehospital prognostic factors to improve the survival of patients with OHCA, among which the association between socioeconomic status (SES) and survival has been reported. SES could affect bystander cardiopulmonary resuscitation rates and whether OHCA is witnessed, and low cardiopulmonary resuscitation education rates are associated with low SES. It has been reported that areas with high SES have shorter hospital transfer times and more public defibrillators per person. Previous studies have shown the impact of SES disparities on the short-term survival of patients with OHCA. However, understanding the impact of SES on the long-term prognosis of OHCA survivors remains limited. As long-term outcomes are more indicative of a patient's ongoing health care needs and the burden on public health than short-term outcomes, understanding the long-term prognosis of OHCA

survivors is important. OBJECTIVE: This study aimed to identify whether SES influenced the long-term outcomes of OHCA. METHODS: Using health claims data obtained from the National Health Insurance (NHI) service in Korea, we included OHCA survivors who were hospitalized between January 2005 and December 2015. The patients were divided into 2 groups: NHI and Medical Aid (MA) groups, with the MA group defined as having a low SES. Cumulative mortality was estimated using the Kaplan-Meier method, and a Cox proportional hazards model was used to evaluate the impact of SES on long-term mortality. A subgroup analysis was performed based on whether cardiac procedures were performed. RESULTS: We followed 4873 OHCA survivors for up to 14 years (median of 3.3 years). The Kaplan-Meier survival curve showed that the MA group had a significantly decreased long-term survival rate compared to the NHI group. With an adjusted hazard ratio (aHR) of 1.52 (95% CI 1.35-1.72), low SES was associated with increased long-term mortality. The overall mortality rate of the patients who underwent cardiac procedures in the MA group was significantly higher than that of the NHI group (aHR 1.72, 95% CI 1.05-2.82). The overall mortality rate of patients without cardiac procedures was also increased in the MA group compared to the NHI group (aHR 1.39, 95% CI 1.23-1.58). CONCLUSIONS: OHCA survivors with low SES had an increased risk of poor long-term outcomes compared with those with higher SES. OHCA survivors with low SES who have undergone cardiac procedures need considerable care for long-term survival.

**14.** Eur J Trauma Emerg Surg. 2023 Jul 10. doi: 10.1007/s00068-023-02271-3. Online ahead of print.
**Cardiac arrest in the perioperative period: a consensus guideline for identification, treatment, and prevention from the European Society of Anaesthesiology and Intensive Care and the European Society for Trauma and Emergency Surgery.**
Hinkelbein J(1), Andres J(2), Böttiger BW(3), Brazzi L(4), De Robertis E(5), Einav S(6), Gwinnutt C(7), Kuvaki B(8), Krawczyk P(9), McEvoy MD(10), Mertens P(11), Moitra VK(12), Navarro-Martinez J(13), Nunnally ME(14), O Connor M(15), Rall M(16), Ruetzler K(17), Schmitz J(3), Thies K(18), Tilsed J(19), Zago M(20), Afshari A(21).
**ABSTRACT**
INTRODUCTION: Cardiac arrest in the operating room is a rare but potentially life-threatening event with mortality rates of more than 50%. Contributing factors are often known, and the event is recognised rapidly as patients are usually under full monitoring. This guideline covers the perioperative period and is complementary to the European Resuscitation Council guidelines. MATERIAL AND METHODS: The European Society of Anaesthesiology and Intensive Care and the European Society for Trauma and Emergency Surgery jointly nominated a panel of experts to develop guidelines for the recognition, treatment, and prevention of cardiac arrest in the perioperative period. A literature search was conducted in MEDLINE, EMBASE, CINAHL and the Cochrane Central Register of Controlled Trials. All searches were restricted to publications from 1980 to 2019 inclusive and to the English, French, Italian and Spanish languages. The authors also contributed individual, independent literature searches. RESULTS: This guideline contains background information and recommendation for the treatment of cardiac arrest in the operating room environment, and addresses controversial topics such as open chest cardiac massage, resuscitative endovascular balloon occlusion and resuscitative thoracotomy, pericardiocentesis, needle decompression, and thoracostomy. CONCLUSIONS: Successful prevention and management of cardiac arrest during anaesthesia and surgery requires anticipation, early recognition, and a clear treatment plan. The ready availability of expert staff and equipment must also be taken into consideration. Success not only depends on medical knowledge, technical skills and a well-organised team using crew resource management, but also on an institutional safety culture embedded in everyday practice through continuous education, training, and multidisciplinary co-operation.

**15.** Medicine (Baltimore). 2023 Jul 7;102(27):e34235. doi: 10.1097/MD.0000000000034235.
**Effects of team leaders' position in cardiopulmonary resuscitation teams on leadership behavior and team performance: A prospective randomized interventional cross-over simulation-based trial.**
Kern P(1), Tschan F(2), Semmer NK(3), Marsch S(1).
**ABSTRACT**
BACKGROUND: Leadership is an important performance factor in resuscitation teams. Medical guidelines for cardiopulmonary resuscitation (CPR) advise team leaders to keep hands off patients. There is little evidence for this recommendation that is based purely on observational data. Accordingly, the aim of this trial was to investigate the effect of leaders' position during CPR on leadership behavior and team performance. METHOD: This is a prospective randomized interventional crossover simulation-based single center trial. Teams of 3 to 4 physicians each, representing a rapid response team, were confronted with a simulated cardiac arrest. Team leaders were randomly assigned and assigned team leaders were 1:1 randomized to 2 leadership positions: position at the patient's head; and hands-off position. Data analysis was performed from video-recordings. All utterances during the first 4 minutes of CPR were transcribed and coded based on a modified "Leadership Description Questionnaire." The primary endpoint was the number of leadership statements. Secondary outcomes included CPR related performance markers like hands-on time and chest compression rate, and the behavioral related endpoints Decision Making, Error Detection, and Situational Awareness. RESULTS: Data from 40 teams (143 participants) was analyzed. Leaders in hands-off position made more leadership statements (28 ± 8 vs 23 ± 8; P <.01) and contributed more to their team's leadership (59 ± 13% vs 50 ± 17%; P = .01) than leaders in the head position. Leaders' position had no significant effect on their teams' CPR performance, Decision Making, and Error Detection. Increased numbers of leadership statements lead to improved hands-on time ( R = 0.28; 95% confidence interval 0.05-0.48; P = .02). CONCLUSIONS: Team leaders in a hands-off position made more leadership statements and contributed more to their teams' leadership during CPR than team leaders actively involved in the head position. However, team leaders' position had no effect on their teams' CPR performance.

**16.** Prehosp Disaster Med. 2023 Jul 14:1-8. doi: 10.1017/S1049023X23006040. Online ahead of print.
**Impact of Heavy Snowfall on Emergency Transport and Prognosis of Out-of-Hospital Cardiac Arrest Patients: A Nation-Wide Cohort Study.**
Omatsu K(1)(2), Uchiyama M(1), Shimizu U(1), Ling Y(3), Okuda S(3), Koyama Y(1).
**ABSTRACT**
BACKGROUND: Out-of-hospital cardiac arrest (OHCA) is a significant global cause of mortality, and Emergency Medical Services (EMS) response interval is critical for survival and a neurologically-favorable outcome. Currently, it is unclear whether EMS response interval, neurologically-intact survival, and overall survival differ between snowy and non-snowy periods at heavy snowfall areas. METHODS: A nation-wide population-based cohort of OHCA patients, registered from 2017 through 2019 in the All-Japan Utstein Registry, was divided into four groups according to areas (heavy snowfall area or other area) and seasons (winter or non-winter): heavy snowfall-winter, heavy snowfall-non-winter, other area-winter, and other area-non-winter. The first coprimary outcome was EMS response interval, and the secondary coprimary outcome was one-month survival and a neurologically-favorable outcome at one month. RESULTS: A total of 337,781 OHCA patients were divided into four groups: heavy snowfall-winter (N = 15,627), heavy snowfall-non-winter (N = 97,441), other area-winter (N = 32,955), and other area-non-winter (N = 191,758). Longer EMS response intervals (>13 minutes) were most likely in the heavy snowfall-winter group (OR = 1.86; 95% CI, 1.76 to 1.97), and also more likely in heavy snowfall areas in non-winter (OR = 1.44; 95% CI,

1.38 to 1.50). One-month survival in winter was worse not only in the heavy snowfall area (OR = 0.86; 95% CI, 0.78 to 0.94) but also in other areas (OR = 0.91; 95% CI, 0.87 to 0.94). One-month neurologically-favorable outcomes were also comparable between heavy snowfall-winter and other area-non-winter groups. CONCLUSIONS: This study showed OHCA in heavy snowfall areas in winter resulted in longer EMS response intervals. However, heavy snowfall had little effect on one-month survival or neurologically-favorable outcome at one month.

**17.** Resuscitation. 2023 Jul 12;190:109901. doi: 10.1016/j.resuscitation.2023.109901. Online ahead of print.

**Racial and ethnic disparities in the provision of bystander CPR after witnessed out-of-hospital cardiac arrest in the United States.**

Toy J(1), Bosson N(2), Schlesinger S(3), Gausche-Hill M(2).

**ABSTRACT**

OBJECTIVE: To evaluate the association between race/ethnicity and the odds of receiving bystander cardiopulmonary resuscitation (bCPR) after witnessed out-of-hospital cardiac arrest (OHCA). METHODS: For this cross-sectional retrospective study, data were obtained from the National Emergency Medical Services Information System database for adults (≥18 years) with a witnessed non-traumatic OHCA in the year 2021. Patients were separated into two groups including Black/Hispanic and White. The primary outcome was the odds of receiving bCPR. We excluded traumatic etiology, do-not-resuscitate orders, and arrest in a healthcare facility or wilderness location. Multiple logistic regression controlling for known covariates was utilized and analyses were stratified by public versus non-public location, median household income, and rural, suburban, or urban setting. RESULTS: A total of 64,007 witnessed OHCAs were included. When compared to White, the Black/Hispanic group were younger (62 vs 67 years) and more often female (40% vs 33%), in neighborhoods with the lowest median household income (31% vs 13%) and in an urban setting (92% vs 80%). Overall, bystander CPR rates were 60% and 67% for the Black/Hispanic and White groups, respectively. Multiple logistic regression stratified by OHCA location found that the Black/Hispanic group had a decreased odds of receiving bCPR compared to the White group both in the home (adjusted OR [aOR] 0.77; 95% CI 0.74-0.81) and in public (aOR 0.69; 95% CI 0.64-0.76). This difference persisted throughout neighborhoods of different socioeconomic status and across the rural-urban spectrum. CONCLUSIONS: Racial/ethnic disparities exist for Black and Hispanic persons in the odds of receiving bCPR after a witnessed non-traumatic OHCA regardless of public or private setting, neighborhood income level, or population density.

**18.** Curr Probl Cardiol. 2023 Jul 7;48(11):101939. doi: 10.1016/j.cpcardiol.2023.101939. Online ahead of print.

**Predicting Risk of Cardiac Arrest in Young Asian Americans: Insights from an Artificial Neural Network Analysis of the Nationwide Cohort.**

Desai R(1), Mohammed AS(2), Gurram P(3), Srikanth S(4), Vyas A(5), Katukuri N(6), Sanku K(7), Paul TK(8), Kumar G(9), Sachdeva R(10).

**ABSTRACT**

We used the Artificial Neural Network (ANN) model to identify predictors of Sudden Cardiac Arrest (SCA) in a national cohort of young Asian patients in the United States. The National Inpatient Sample (2019) was used to identify young Asians (18-44-year-old) who were hospitalized with SCA. The neural network's predicted criteria for SCA were selected. After eliminating missing data, young Asians (n = 65,413) were randomly divided into training (n = 45,094) and testing (n = 19347) groups. Training data (70%) was used to calibrate ANN while testing data (30%) was utilized to assess the algorithm's accuracy. To determine ANN's performance in predicting SCA, we compared the

frequency of incorrect prediction between training and testing data and measured the area under the Receiver Operating Curve (AUC). The 2019 young Asian cohort had 327,065 admissions (median age 32 years; 84.2% female), with SCA accounting for 0.21%. The exact rate of error in predictions vs. tests was shown by training data (0.2% vs 0.2%). In descending order, the normalized importance of predictors to accurately predict SCA in young adults included prior history of cardiac arrest, sex, age, diabetes, anxiety disorders, prior coronary artery bypass grafting, hypertension, congenital heart disease, income, peripheral vascular disease, and cancer. The AUC was 0.821, indicating an excellent ANN model for SCA prediction. Our ANN models performed excellently in revealing the order of important predictors of SCA in young Asian American patients. These findings could have a considerable impact on clinical practice to develop risk prediction models to improve the survival outcome in high-risk patients.

**19.** Prehosp Emerg Care. 2023 Jul 20:1-12. doi: 10.1080/10903127.2023.2239363. Online ahead of print.

**Documented Use of Emergency Medical Dispatch Protocols is Associated with Improved Survival in Out of Hospital Cardiac Arrest.**

Colgan A(1), Swanson MB(2)(3), Ahmed A(4), Harland K(3), Mohr NM(2)(3)(5).

**ABSTRACT**

OBJECTIVEThere are over 300,000 out-of-hospital cardiac arrests (OHCA) annually in the United States (US) and despite many scientific advances in the field, the survival rate remains low. We seek to determine if return of spontaneous circulation (ROSC) is higher when use of emergency medical dispatch (EMD) protocols is documented for OHCA calls compared to when no EMD protocol use is documented. We also seek identify care-related processes that differ in calls that use EMD protocols. METHODSThis is a retrospective cohort study of U.S. adults with OHCA prior to emergency medical services (EMS) arrival using 2019 National EMS Information System data. The primary exposure was EMD usage during EMS call. The primary outcome was prehospital ROSC, and secondary outcomes included automated external defibrillator (AED) use before EMS arrival, bystander CPR, and end-of-event EMS survival (survival to the end of the EMS care at transport destination). Multivariable logistic regression adjusted for age, sex, race/ethnicity, primary insurance, rurality, initial rhythm, arrest etiology, and witnessed arrest.RESULTSOf the 96,269 OHCA cases included, EMD use was documented in 73%. Overall, 26% of subjects achieved ROSC in EMS care. EMD subjects were more likely to achieve ROSC (27.2% vs. 23.5%, uOR 1.22, 95%CI 1.18 - 1.26) even after adjusting for subject and arrest characteristics (aOR 1.13, 95%CI 1.08 - 1.17). EMD subjects also had higher end-of-event survival (19.1% vs. 16.4%, aOR 1.20, 95%CI 1.15 - 1.25). AED use before EMS arrival was more common in the EMD group (28.3% vs. 26.3% %diff 2.0, 95%CI 1.4 to 2.6), as was CPR before EMS arrival (63.8% vs. 55.1%, difference 8.6%, 95%CI 7.9 to 9.3%). CONCLUSIONSIn this retrospective analysis, the rate of ROSC was higher in adult OHCA patients when EMD protocol use was reported compared to when it was not reported. The group with documented EMD use also experienced higher rates of bystander AED use, bystander CPR, and end-of-event survival.

**20.** Afr J Emerg Med. 2023 Sep;13(3):199-203. doi: 10.1016/j.afjem.2023.06.006. Epub 2023 Jul 6.

**Accuracy of two-rescuer adult CPR performed by medical registrars at a South African university.**

Hartslief B(1), Janse van Rensburg C(1), Maartens A(1), Marais PG(1), Meyer ET(1), Cairncross JP(1), Joubert G(2), Steinberg WJ(1).

**ABSTRACT**

BACKGROUND: Cardiopulmonary resuscitation (CPR) is performed to manually keep brain function intact until the patient's spontaneous blood circulation and breathing are restored. In South Africa,

registrars, who are qualified doctors training to specialise in a medical field, are usually the team leaders and oversee junior doctors and nurses during resuscitation. OBJECTIVES: This study aimed to determine the accuracy of the execution of two-rescuer adult CPR on a Resusci-Anne® manikin performed by registrars from the University of the Free State, South Africa. METHODS: A cross-sectional study was conducted. From a target population of 142 registrars, 47 participated, of whom 44 were included in the analysis. During five cycles of CPR, compression quality was assessed. During a subsequent five cycles, airway management was assessed. Participants were evaluated executing CPR on the Resusci-Anne® manikin, with a recently Basic Life Support trained student researcher as second rescuer. A modified version of the American Heart Association's tick sheet for two-rescuer adult CPR was completed by two student researchers. Department, gender and the date of the most recent CPR training attended were recorded. RESULTS: The median total percentage score was 82.2% (range 33.3% to 100.0%). Results showed that 88.6% of registrars consistently demonstrated correct hand placement, 25.0% correct compression rate, 93.2% correct compression depth, and 61.4% allowed complete chest recoil during compressions. Consistently correct E-C technique was found in 77.3%, and correct ventilation rate in 93.2%. Only 63.6% correctly managed an open airway, and 61.4% achieved visible chest rise. A consistently correct compression-to-ventilation ratio was performed by 59.1% of registrars. CONCLUSION: The study found that registrars were not consistently performing high-quality CPR on a Resusci-Anne® manikin and identified areas needing attention. The results of this study highlight the need for compulsory CPR training and regular fire drills for registrars.

**21.** Disabil Health J. 2023 Jun 29:101501. doi: 10.1016/j.dhjo.2023.101501. Online ahead of print.
**Cardiopulmonary resuscitation and basic life support for people with atypical chest shapes and wheelchair users: Toward supplemented education and emergency management plans.**
Deegan E(1), Wilson NJ(2), Pullin LH(2), Lewis P(2).
**ABSTRACT**
This article explores current practice issues in basic life support (BLS) and cardiopulmonary resuscitation (CPR) delivery for people with disability and poses recommendations for development of education and training where specialist nurses and other health professionals can facilitate BLS and CPR techniques catering for people with atypical chest shapes wheelchair users and people at high risk of choking. People with a disability are at higher risk of premature and unexpected death. At present there is a significant gap in knowledge about how to deliver optimal BLS or CPR to people with atypical chest shapes wheelchair users and people at high risk of choking. This leave carers to augment guidelines during emergency situations. Introduction of supplemented BLS and CPR together with development of emergency care plans for people with disability could reduce the number of people with disability dying premature or preventable deaths.

**22.** Can Med Educ J. 2023 Jun 27;14(3):99-106. doi: 10.36834/cmej.74401. eCollection 2023 Jun.
**The timing of booster sessions may not improve resuscitation skill retention among healthcare providers: a randomized controlled trial.**
Waldolf R(1)(2)(3), Dion PM(4), Bould D(5), Bould C(5), Crnic A(5), Etherington C(5)(6), McBride G(7), Boet S(2)(3)(5)(6)(8)(9).
**ABSTRACT**
INTRODUCTION: Booster sessions can improve cardiopulmonary resuscitation (CPR) skill retention among healthcare providers; however, the optimal timing of these sessions is unknown. This study aimed to explore differences in skill retention based on booster session timing. METHODS: After ethics approval, healthcare providers who completed an initial CPR training course were randomly assigned to either an early booster, late booster, or no booster group. Participants' mean

resuscitation scores, time to initiate compressions, and time to successfully provide defibrillation were assessed immediately post-course and four months later using linear mixed models. RESULTS: Seventy-three healthcare professionals were included in the analysis. There were no significant differences by randomization in the immediate post-test (9.7, 9.2, 8.9) or retention test (10.2, 9.8, and 9.5) resuscitation scores. No significant effects were observed for time to compression. Post-test time to defibrillation (mean ± SE: 112.8 ± 3.0 sec) was significantly faster compared to retention (mean ± SE: 120.4 ± 2.7 sec) ($p = 0.04$); however, the effect did not vary by randomization. CONCLUSION: No difference was observed in resuscitation skill retention between the early, late, and no booster groups. More research is needed to determine the aspects of a booster session beyond timing that contribute to skill retention.

**23.** Healthcare (Basel). 2023 Jul 24;11(14):2110. doi: 10.3390/healthcare11142110.
**Framework Development of Non-Face-to-Face Training of Basic Life Support for Laypersons: A Multi-Method Study.**
Han S(1), Lee CA(2), Jeong WJ(3), Park J(2), Park HA(2).
**ABSTRACT**
The spread of infectious diseases has accelerated the transition from face-to-face (F2F) to non-F2F (NF2F) education. To maintain the effect of successful NF2F education in cardiopulmonary resuscitation, reorganizing the curriculum to suit the NF2F educational environment is necessary. We propose an appropriate learning curriculum for NF2F basic life support (BLS) training for laypersons based on expert surveys and learners' performance outcomes. This study included three stages and used multiple methods. A draft curriculum was created through a literature review and three-round Delphi approach, and then applied as a test for actual education. After the training, the final curriculum of the NF2F BLS training for laypersons was proposed by reflecting on the performance outcomes of learners and expert opinions. NF2F theoretical education was simplified into five content items: concept of chain of survival, legal protection for first aiders, importance of bystander cardiopulmonary resuscitation, how to recognize a patient in cardiac arrest and activate the emergency medical services system, and reduced training time. In the hands-on skills session, it was recommended to practice chest compressions using a simple intuitive feedback device and to use automated external defibrillators step-by-step more than in F2F training. In conclusion, NF2F training is a suitable option for BLS training methods in situations where F2F training is difficult.

**24.** Healthcare (Basel). 2023 Jul 20;11(14):2073. doi: 10.3390/healthcare11142073.
**The Perspective of the General Population in Saudi Arabia towards Do-Not-Resuscitate (DNR) Orders: A Cross-Sectional Study.**
Qutob RA(1), Aljarba NK(1), Alhusaini BA(1), Alzaid ON(1), Alghamdi AH(1), Alaryni AA(1), Bukhari AI(1), Alburakan A(2), Alanazi AM(1), Alsolamy EN(1), Alfozan OA(1), Alzmamy SA(1), Ababtain AA(3), Elhazmi A(4), Hakami OA(1).
**ABSTRACT**
OBJECTIVES: In the event of cardiac arrest, cardiopulmonary resuscitation (CPR) is an emergency procedure used to maintain the heart and lungs functional simultaneously. The do-not-resuscitate (DNR) order prohibits CPR and is therefore legally required. Despite this, a DNR remains a delicate and contentious issue that places physicians in morally ambiguous situations. This study aimed to assess Saudi citizens' understanding of DNR orders, prior exposure to them, and preferences for DNR conversations. METHODS: This was an online cross-sectional study that was conducted between January and April 2023 and aimed to assess the knowledge regarding DNR orders among Saudi populations. This study adapted a previously developed questionnaire tool by Al Ahmadi et al., which examined the knowledge and attitude toward do-not-resuscitate among patients and their

relatives visiting outpatient clinics. Binary logistic regression analysis was the mean knowledge score for the study participants. RESULTS: A total of 920 participants were involved in this study. Almost half of the study participants (49.6%) reported that they had heard of DNR before. The most commonly reported source of their information on DNR was healthcare providers (58.2%). The mean knowledge score of the study participants was 1.9 (1.3) out of 6, which is equal to 31.7% of the total maximum score. This demonstrates the weak level of knowledge about DNR among the general public. Females, divorced, and those who had a post-graduate level of education were more likely to be knowledgeable of DNR compared to others ($p < 0.05$). Around one-quarter of the study participants showed agreement with DNR. More than half of them (59.5%) believe that physicians should be involved in DNR decision making. CONCLUSIONS: Saudi Arabia's general community has limited knowledge of DNR. It is recommended that healthcare professionals increase patients' and caregivers' understanding of this concept. This will improve the planning and the provision of end-of-life care.

**25.** Healthcare (Basel). 2023 Jul 17;11(14):2047. doi: 10.3390/healthcare11142047.
**The Effect of Cardiopulmonary Resuscitation (CPR) Education on the CPR Knowledge, Attitudes, Self-Efficacy, and Confidence in Performing CPR among Elementary School Students in Korea.**
Ko JS(1), Kim SR(2), Cho BJ(1).
**ABSTRACT**
Cardiopulmonary resuscitation (CPR) education for schoolchildren is emphasized, as bystander CPR is a vital key to increasing the survival rate of out-of-hospital cardiac arrest (OHCA) victims. This study was conducted to verify the effect of CPR education on knowledge, attitudes, self-efficacy, and confidence of Korean elementary school students in performing CPR. Data were collected through structured questionnaires before and after CPR education and analyzed using descriptive statistics, T-tests, and hierarchical regression. Significant improvements in CPR knowledge, attitudes, self-efficacy, and confidence in performing CPR were found after CPR education, with the greatest increase observed in confidence ($p = 0.000$). The influencing factors on confidence in performing CPR were school grade, attitude, and self-efficacy. Although a significant increase in schoolchildren's CPR knowledge after education was shown, knowledge did not affect confidence in performing CPR. Therefore, early CPR education which focuses on improving confidence in performing CPR is recommended. CPR education might raise attitude and self-efficacy leading to increased confidence in performing bystander CPR. In conclusion, early and regular CPR education for elementary school students is crucial and should be conducted repeatedly.

**26.** Resuscitation. 2023 Jul 26:109914. doi: 10.1016/j.resuscitation.2023.109914. Online ahead of print.
**Out-of-Hospital Cardiac Arrest Survival When CPR is Initiated by First Responders.**
El-Zein RS(1), Kennedy KF(2), Chan PS(3).
**ABSTRACT**
BACKGROUND: In most patients with out-of-hospital cardiac arrest (OHCA), cardiopulmonary resuscitation (CPR) is initiated by first responders (non-transporting firefighters or police) or emergency medical service (EMS) personnel. Whether survival outcomes differ when CPR is initiated by first responders vs. EMS is unclear. METHODS: Within the CARES registry, we identified 162,896 adult patients with a non-traumatic OHCA in whom CPR was initiated by first responders or EMS during 2013-2021. Using multivariable hierarchical logistic regression to adjust for demographics, cardiac arrest characteristics and time to first CPR, we compared rates of survival to hospital admission and to discharge in patients with CPR initiated by first responders and EMS. RESULTS: CPR was initiated by first responders in 70,889 (43.5%) and by EMS in 92,007 (56.5%) patients. Time to

first CPR was shorter when first responders initiated CPR (median: 8.0 [5.0-13.0] vs. 10.0 minutes [IQR: 6.0-14.0]; standardized difference 16.1%). The likelihood of survival to hospital admission was similar when CPR was initiated by first responders (27.1% [first responders] vs. 26.8% [EMS]; adjusted OR: 0.98 [0.96, 1.01], P=0.15) whereas survival rates to discharge were higher with CPR initiated by first responders (9.4% [first responders] vs. 7.7% [EMS]; adjusted OR: 1.17 [1.02, 1.21], P<0.001). After adjustment for time to first CPR, rates of survival to discharge were similar between the first responder and EMS groups (adjusted OR: 1.04 [1.00-1.08]; P=0.07). CONCLUSIONS: CPR initiated by first responders for OHCA is associated with higher overall survival rates and higher survival was largely mediated by earlier response times.

**27.** PLoS One. 2023 Jul 26;18(7):e0284826. doi: 10.1371/journal.pone.0284826. eCollection 2023.
**Ethical considerations in the prehospital treatment of out-of-hospital cardiac arrest: A multi-centre, qualitative study.**
Milling L(1)(2), Nielsen DS(3)(4), Kjær J(1)(2), Binderup LG(5), de Muckadell CS(5), Christensen HC(6), Christensen EF(7)(8), Lassen AT(9), Mikkelsen S(1)(2).
**ABSTRACT**
BACKGROUND: Prehospital emergency physicians have to navigate complex decision-making in out-of-hospital cardiac arrest (OHCA) treatment that includes ethical considerations. This study explores Danish prehospital physicians' experiences of ethical issues influencing their decision-making during OHCA. METHODS: We conducted a multisite ethnographic study. Through convenience sampling, we included 17 individual interviews with prehospital physicians and performed 22 structured observations on the actions of the prehospital personnel during OHCAs. We collected data during more than 800 observation hours in the Danish prehospital setting between December 2019 and April 2022. Data were analysed with thematic analysis. RESULTS: All physicians experienced ethical considerations that influenced their decision-making in a complex interrelated process. We identified three overarching themes in the ethical considerations: Expectations towards patient prognosis and expectations from relatives, bystanders, and colleagues involved in the cardiac arrest; the values and beliefs of the physician and values and beliefs of others involved in the cardiac arrest treatment; and dilemmas encountered in decision-making such as conflicting values. CONCLUSION: This extensive qualitative study provides an in-depth look at aspects of ethical considerations in decision-making in prehospital resuscitation and found aspects of ethical decision-making that could be harmful to both physicians and patients, such as difficulties in handling advance directives and potential unequal outcomes of the decision-making. The results call for multifaceted interventions on a wider societal level with a focus on advance care planning, education of patients and relatives, and interventions towards prehospital clinicians for a better understanding and awareness of ethical aspects of decision-making.

**28.** J Med Internet Res. 2023 Jul 26;25:e46092. doi: 10.2196/46092.
**Tele-Instruction Tool for Multiple Lay Responders Providing Cardiopulmonary Resuscitation in Telehealth Emergency Dispatch Services: Mixed Methods Study.**
Xu J(#)(1), Qu M(#)(2), Dong X(3), Chen Y(4), Yin H(4), Qu F(4), Zhang L(1)(4).
**ABSTRACT**
BACKGROUND: Telephone-assisted cardiopulmonary resuscitation (T-CPR) has proven to be a crucial intervention in enhancing the ability of lay responders to perform cardiopulmonary resuscitation (CPR) during telehealth emergency services. While the majority of established T-CPR protocols primarily focus on guiding individual rescuers, there is a lack of emphasis on instructing and coordinating multiple lay responders to perform resuscitation collaboratively. OBJECTIVE: This study aimed to develop an innovative team-based tele-instruction tool to efficiently organize and instruct

multiple lay responders on the CPR process and to evaluate the effectiveness and feasibility of the tool. METHODS: We used a mixed methods design in this study. We conducted a randomized controlled simulation trial to conduct the quantitative analysis. The intervention groups used the team-based tele-instruction tool for team resuscitation, while the control groups did not have access to the tool. Baseline resuscitation was performed during the initial phase (phase I test). Subsequently, all teams watched a team-based CPR education training video and finished a 3-person practice session with teaching followed by a posttraining test (phase II test). In the qualitative analysis, we randomly selected an individual from each team and 4 experts in emergency medical services to conduct semistructured interviews. The purpose of these interviews was to evaluate the effectiveness and feasibility of this tool. RESULTS: The team-based tele-instruction tool significantly improved the quality of chest compression in both phase I and phase II tests. The average compression rates were more appropriate in the intervention groups compared to the control groups (median 104.5, IQR 98.8-111.8 min-1 vs median 112, IQR 106-120.8 min-1; P=.04 in phase I and median 117.5, IQR 112.3-125 min-1 vs median 111, IQR 105.3-119 min-1; P=.03 in phase II). In the intervention group, there was a delay in the emergency response time compared to that in the control group (time to first chest compression: median 20, IQR 15-24.8 seconds vs median 25, IQR 20.5-40.3 seconds; P=.03; time to open the airway: median 48, IQR 36.3-62 seconds vs median 73.5, IQR 54.5-227.8 seconds; P=.01). However, this delay was partially mitigated after the phase II test. The qualitative results confirmed the compatibility and generalizability of the team-based tele-instruction tool, demonstrating its ability to effectively guide multiple lay responders through teamwork and effective communication with telecommunicators. CONCLUSIONS: The use of the team-based tele-instruction tool offers an effective solution to enhance the quality of chest compression among multiple lay responders. This tool facilitated the organization of resuscitation teams by dispatchers and enabled efficient cooperation. Further assessment of the widespread adoption and practical application of the team-based tele-instruction tools in real-life rescue scenarios within the telehealth emergency services system is warranted.

**29.** J Am Heart Assoc. 2023 Jul 26:e030087. doi: 10.1161/JAHA.123.030087. Online ahead of print.
**Comparison of Out-of-Hospital Cardiac Arrest Outcomes Between Asian and White Individuals in the United States.**
Gupta K(1)(2), Raj R(3), Asaki SY(4), Kennedy K(1), Chan PS(1)(2).
**ABSTRACT**
Background Disparities in bystander cardiopulmonary resuscitation (CPR) and survival have been reported for Black and Hispanic individuals with out-of-hospital cardiac arrest (OHCA). Whether Asian individuals have lower rates of bystander CPR and survival for OHCA, as compared with White individuals, remains unknown. Methods and Results Within the US-based CARES (Cardiac Arrest Registry to Enhance Survival), we identified 278 989 OHCAs in Asian and White individuals during 2013 to 2021. Using hierarchical Poisson logistic regression with emergency medical service agency modeled as a random effect and patient and OHCA characteristics as fixed effects, we compared rates of bystander CPR, survival to discharge, and favorable neurological survival between Asian and White individuals with OHCA. Overall, 14 835 (5.3%) OHCAs occurred in Asian individuals. Compared with White individuals with OHCA, Asian individuals were older (67.0±17.6 versus 62.8±16.9 years) and were less likely to have drug overdose as the cause of OHCA (1.3% versus 6.6%) and a shockable arrest rhythm (19.2% versus 22.4%). Layperson bystander CPR rates were similar between Asian and White individuals (42.6% versus 42.1%; adjusted relative risk for Asian individuals, 0.99 [95% CI, 0.97-1.02]; P=0.69). However, rates of survival to discharge were lower in Asian individuals with OHCA (8.2% versus 10.3%; adjusted relative risk 0.92 [0.86-0.98] P=0.006). Similarly, the rate of

favorable neurological survival was lower for Asian individuals (6.5% versus 8.7%; adjusted relative risk, 0.85 [0.79-0.91]; P<0.001). Conclusions Despite similar rates of bystander CPR, Asian individuals with OHCA have lower survival rates than White individuals with OHCA. The reasons for the lower survival rate deserve further study to determine whether there are disparities in resuscitation care between Asian and White individuals with OHCA.

**30.** BMJ Open. 2023 Jul 25;13(7):e073481. doi: 10.1136/bmjopen-2023-073481.
**Examining training and attitudes to basic life support in multi-ethnic communities residing in New South Wales, Australia: A mixed-methods investigation.**
Munot S(1), Rugel EJ(2), Bray J(3), Redfern J(4), Yang G(5), Ngo L(6), Bauman A(7), Dang QM(2), Rock Z(2), Marschner S(2), Coggins A(8), Semsarian C(9), Middleton PM(10), Jennings G(11), Angell B(12)(13), Kumar S(2)(14), Kovoor P(14), Chow CK(2)(12)(14)(15).
**ABSTRACT**
BACKGROUND: Bystander response, including cardiopulmonary resuscitation (CPR), is critical to out-of-hospital cardiac arrest (OHCA) survival. Nearly 30% of Australian residents were born overseas, and little is known about their preparedness to perform CPR. In this mixed-methods study, we examined rates of training and willingness and barriers to performing CPR among immigrants in Australia. METHODS: First, we surveyed residents in New South Wales, Australia, using purposeful sampling to enrich immigrant populations. Multivariate logistic regression was used to examine the association between place of birth and willingness to perform CPR. Next, we conducted focus-group discussions with members of the region's largest migrant groups to explore barriers and relevant societal or cultural factors. RESULTS: Of the 1267 survey participants (average age 49.6 years, 52% female), 60% were born outside Australia, most in Asia and 73% had lived in Australia for more than 10 years. Higher rates of previous CPR training were reported among Australian-born participants compared with South Asian-born and East Asian-born (77%, 35%, 48%, respectively, p <0.001). In adjusted models, the odds of willingness to perform CPR on a stranger were significantly lower among migrants than Australian-born (adjusted OR: 0.64; 95% CI 0.49 to 0.83); however, this association was mediated by history of training. Themes emerging from the focus-group discussions included concerns about causing harm, fear of liability, and birthplace-specific social and cultural barriers. CONCLUSIONS: Targeted awareness and training interventions, which address common and culture-specific barriers to response and improved access to training, may improve confidence and willingness to respond to OHCA in multi-ethnic communities.

**31.** Cureus. 2023 Jun 21;15(6):e40729. doi: 10.7759/cureus.40729. eCollection 2023 Jun.
**Using the Evidence-Development-Validation-Consensus (EDVC) Approach to Develop and Validate maxSIMdrone: A Training Program for Healthcare Professionals to Provide Cardiac Arrest Care Using Drones.**
Gino B(1)(2), Benson A(3), Dubrowski A(2).
**ABSTRACT**
Introduction The challenges of delivering cardiac arrest (CA) courses in rural and remote (R&R) locations worldwide have been further exacerbated by the COVID-19 pandemic. However, it is important to note that this problem has always existed. The implementation of social distancing measures to combat the pandemic has had a significant impact on healthcare and medical education, particularly in relation to the training of students, laypeople (LP), and healthcare professionals (HCPs) in CA care. The combination of pandemic restrictions and pre-existing difficulties faced in R&R locations and large cities has disrupted the provision of comprehensive medical education. The suspension of basic life support and defibrillation (BLSD) courses during the pandemic may have negatively affected pre-hospital care for CA. However, it is essential to

acknowledge that challenges in delivering these courses in R&R areas predate the pandemic. Materials and methods A 2021 epidemiological study in the Brazilian Amazon identified CA as the primary cause of death, followed by COVID-19. This highlights the importance of providing BLSD courses and training to emergency medical service (EMS) personnel in R&R locations. Even during a pandemic. Researchers from Ontario Tech University and Memorial University School of Medicine developed a drone with a simulation scenario to train HCPs in automated external defibrillators (AED) operation and guide LP in safe use through BLSD protocols. A literature review showed that different training methods yielded similar outcomes. Based on these findings, the evidence-development-validation-consensus (EDVC) hybrid approach was used to develop and validate an online training program using a learning management system (LMS) as a model. Results Teaching HCPs and LP in R&R locations, such as northern Canada and the Brazilian Amazon, presents challenges due to limited resources and internet access. One potential solution lies in the utilization of remote online LMS that facilitate the administration, documentation, tracking, reporting, automation, and delivery of educational courses and training programs. The literature review indicated that mixed training approaches, including face-to-face, online, and hybrid formats, produced similar outcomes in learning assessment, self-confidence, performance, skills, and knowledge acquisition. These findings support the viability of using LMS as a model to develop and validate a course where drones deliver AEDs and provide training to HCPs and LP in R&R locations. A comprehensive training program should encompass cognitive, affective, and psychomotor learning domains, addressing various skills and knowledge aspects. Conclusion This research study develops and validates LMS teaching methods to support a training program for HCPs and LP in using AEDs delivered by drones. The program combines design-based research and consensus development methods, such as design thinking and think-aloud observations. Drones are used to provide AEDs and develop simulation scenarios for training in R&R locations. The hybrid approach ensures a valid and evidence-based training program. The study presents the EDVC approach used to enhance the maxSIMdrone training program, enabling effective out-of-hospital CA care. The program incorporates participant feedback and improves knowledge and techniques in AED use. It has the potential to improve patient outcomes in resource-limited R&R locations.

**32.** Int J Emerg Med. 2023 Jul 24;16(1):44. doi: 10.1186/s12245-023-00521-0.

**Basic life support awareness among medical undergraduate students in Syria, Iraq, and Jordan: a multicenter cross-sectional study.**

Alkarrash MS(1), Shashaa MN(1), Kitaz MN(1), Rhayim R(1), Ismail M(1), Swed S(2), Hafez W(3)(4), Kaadan MI(5)(6), Koumakli H(7), Alhisah N(8), Al-Haider A(9), Al-Salloum S(10), Cherrez-Ojeda I(11)(12).

**ABSTRACT**

BACKGROUND AND AIMS: Basic life support (BLS) training rates vary widely worldwide, and there is a general scarcity of surveys that assess students' knowledge and awareness of BLS in middle eastern nations. This study aims to evaluate medical students' knowledge and awareness towards basic life support. METHODS: A cross-sectional study, using an online web-based questionnaire, assessing BLS awareness and knowledge, was conducted from 3 to 30 November 2021. The study included 2114 medical students from Syria, Iraq, and Jordan. The questionnaire consisted of three sections: demographic baseline characteristics, knowledge about BLS, and ability to apply basic life support. A binominal logistic regression was done between the total score and other demographic characteristics to determine if we could predict the research sample's appropriate knowledge of BLS level. RESULTS: There was a moderate knowledge of BLS and cardiopulmonary resuscitation (CPR) skills among participating students with an average score of 19.67 (0-34). Seventy-eight of the participants (1656) stated that they have not attended a basic life support course. There was a

significant difference between the participants from different countries, where the mean score in Syria, Jordan, and Iraq was 18.3, 24.3, and 18.8, respectively ($p < 0.05$). Considering the level of knowledge, 18.3%, 72.8%, and 8.9% of the participants had a high, intermediate, and low level, respectively. Furthermore, students who took a BLS course had a higher level of knowledge than those who did not, with an odds ratio of 5.168 (p value < 0.0001). CONCLUSION: The overall knowledge of medical students' basic life support knowledge is insufficient and need to be greatly improved. According to this study, previous participation in basic life support training had a positive effect on knowledge level. As a result, universities must establish basic life support programs as quickly as possible.

**33.** Children (Basel). 2023 Jul 22;10(7):1266. doi: 10.3390/children10071266.

**Knowledge and Attitudes around First Aid and Basic Life Support of Kindergarten and Elementary School Teachers and Parents in Taif City, Saudi Arabia.**

Tamur S(1), Alasmari RM(2), Alnemari MA(2), Altowairgi MA(2), Altowairqi AH(2), Alshamrani NM(2), Aljaid M(1), Al-Malki S(1), Khayat A(1), Alzahrani A(1), Shams A(3)(4)(5).

**ABSTRACT**

BACKGROUND: The foremost cause of children's (1-19 year) death is inadvertent injuries. While most of these accidental harms occur at home and school, rapid and suitable parental and teacher intervention is required to increase the chances of a child's survival. Therefore, both parents and teachers of the children in kindergarten and elementary school must be knowledgeable in first aid practice and basic life support (BLS) training. OBJECTIVES: In the current study, our ambition is to evaluate the orientation level, knowledge, and attitudes around first aid and BLS training of kindergarten and elementary school teachers and parents in the city of Taif, Makkah region. METHODS: A cross-sectional study in Taif, Saudi Arabia, targeted kindergarten and elementary school teachers and parents of students enrolled at these levels. There were 648 participants included in this study. The researchers assessed teachers' and parents' knowledge and attitudes around first aid and BLS using a validated, self-administered online questionnaire. RESULTS: The study included 648 participants, including 248 (38.3%) teachers and 400 (61.7%) parents. The socio-demographic analysis showed that 412 (63.6%) are females and 233 (36.5%) are between the ages of 36 and 45 years. Approximately 142 (21.9%) participants reported previous training in the cardiopulmonary resuscitation (CPR) program, though more than half of them (53.5%) had outdated certificates (more than 2 years). The mean total knowledge for our study was 4.6 ± 1.4, with 22.4% of the participants being educated about first aid support and expressing a fair level of CPR foundations. Only a small percentage (2.3%) of the participants exposed a good and adequate theoretical level of knowledge around CPR skills and performance, while most of the contributors unveiled a poor level of knowledge (over 75%). There were no statistically significant differences between parents and teachers ($p > 0.05$). Finally, numerous participants (85%) appreciated training in the CPR program, and the most common motive was a "wish to avoid unnecessary death". CONCLUSIONS: We concluded that a sizable portion of the contributors expressed a lack of proficiency in the fundamental CPR training knowledge and skills, pointing to an alarming public concern. Promisingly, a sizable percentage of participants expressed motivated attitudes toward CPR training. Therefore, additional study and data are required to effectively combat injury, with an emphasis on investigating causes and risk factors, burden and socioeconomic health determinants, community awareness level and desire to contribute, and accessibility for disseminating specific intervention strategies.

**POST-CARDIAC ARREST TREATMENTS**

**1.** Resuscitation. 2023 Jul;188:109832. doi: 10.1016/j.resuscitation.2023.109832. Epub 2023 May 11.
**Validation of the rCAST score and comparison to the PCAC and FOUR scores for prognostication after out-of-hospital cardiac arrest.**
Kim N(1), Kitlen E(1), Garcia G(1), Khosla A(2), Miller PE(3), Johnson J(4), Wira C(5), Greer DM(6), Gilmore EJ(1), Beekman R(7).

**ABSTRACT**
AIM: Early, accurate outcome prediction after out-of-hospital cardiac arrest (OHCA) is critical for clinical decision-making and resource allocation. We sought to validate the revised post-Cardiac Arrest Syndrome for Therapeutic hypothermia (rCAST) score in a United States cohort and compare its prognostic performance to the Pittsburgh Cardiac Arrest Category (PCAC) and Full Outline of UnResponsiveness (FOUR) scores. METHODS: This is a single-center, retrospective study of OHCA patients admitted between January 2014-August 2022. Area under the receiver operating curve (AUC) was computed for each score for predicting poor neurologic outcome at discharge and in-hospital mortality. We compared the scores' predictive abilities via Delong's test. RESULTS: Of 505 OHCA patients with all scores available, the medians [IQR] for rCAST, PCAC, and FOUR scores were 9.5 [6.0, 11.5], 4 [3, 4], and 2 [0, 5], respectively. The AUC [95% confidence interval] of the rCAST, PCAC, and FOUR scores for predicting poor neurologic outcome were 0.815 [0.763-0.867], 0.753 [0.697-0.809], and 0.841 [0.796-0.886], respectively. The AUC [95% confidence interval] of the rCAST, PCAC, and FOUR scores for predicting mortality were 0.799 [0.751-0.847], 0.723 [0.673-0.773], and 0.813 [0.770-0.855], respectively. The rCAST score was superior to the PCAC score for predicting mortality ($p = 0.017$). The FOUR score was superior to the PCAC score for predicting poor neurological outcome ($p < 0.001$) and mortality ($p < 0.001$). CONCLUSION: The rCAST score can reliably predict poor outcome in a United States cohort of OHCA patients regardless of TTM status and outperforms the PCAC score.

**2.** Resuscitation. 2023 Jul;188:109826. doi: 10.1016/j.resuscitation.2023.109826. Epub 2023 May 11.
**Electrocardiographic characteristics fail to predict acute coronary occlusions in out-of-hospital cardiac-arrest patients without ST-segment elevation.**
Leeper B(1), Kern KB(2), Liu S(3), Sun X(3).

**ABSTRACT**
BACKGROUND: A minority of out-of-hospital cardiac arrest patients have an acutely occluded coronary artery without manifesting ST-segment elevation on their post-resuscitation ECG. Identifying such patients is an issue to providing timely reperfusion therapy. We aimed to evaluate the usefulness of the initial post-resuscitation electrocardiogram in out-of-hospital-cardiac-arrest patients for selection to perform early coronary angiography. METHODS: The study population consisted of 74 of the 99 randomized patients from the PEARL clinical trial with both ECG and angiographic data. The purpose of this study was to investigate initial post-resuscitation electrocardiogram findings from out-of-hospital cardiac arrest patients without ST-segment elevation for any association with the presence of acute coronary occlusions. Secondarily, we aimed to observe the distribution of abnormal electrocardiogram findings and survival to hospital discharge of subjects. RESULTS: Initial post-resuscitation electrocardiogram findings, including ST-depression, T-wave inversion, bundle branch block, non-specific changes, were not associated with the presence of an acutely occluded coronary. Normal post-resuscitation electrocardiogram findings were associated with patient survival to hospital discharge but were not associated with the presence or absence of an acute coronary occlusion. CONCLUSIONS: Electrocardiogram findings cannot exclude or identify the presence of an acutely occluded coronary in out-of-hospital-cardiac-arrest patients without ST-segment elevation. An acutely occluded coronary may be present regardless of normal electrocardiogram findings.

**3.** Resuscitation. 2023 Jul;188:109785. doi: 10.1016/j.resuscitation.2023.109785. Epub 2023 Apr 3.

**Diagnostic yield, safety, and outcomes of Head-to-pelvis sudden death CT imaging in post arrest care: The CT FIRST cohort study.**

Branch KRH(1), Gatewood MO(2), Kudenchuk PJ(3), Maynard C(4), Sayre MR(2), Carlbom DJ(5), Edwards RM(6), Counts CR(2), Probstfield JL(3), Brusen R(7), Johnson N(2), Gunn ML(8).

**ABSTRACT**

AIM: Our aim was to test whether a head-to-pelvis CT scan improves diagnostic yield and speed to identify causes for out of hospital circulatory arrest (OHCA). METHODS: CT FIRST was a prospective observational pre-/post-cohort study of patients successfully resuscitated from OHCA. Inclusion criteria included unknown cause for arrest, age >18 years, stability to undergo CT, and no known cardiomyopathy or obstructive coronary artery disease. A head-to-pelvis sudden death CT (SDCT) scan within 6 hours of hospital arrival was added to the standard of care for patients resuscitated from OHCA (post-cohort) and compared to standard of care (SOC) alone (pre-cohort). The primary outcome was SDCT diagnostic yield. Secondary outcomes included time to identifying OHCA cause and time-critical diagnoses, SDCT safety, and survival to hospital discharge. RESULTS: Baseline characteristics between the SDCT (N = 104) and the SOC (N = 143) cohorts were similar. CT scans (either head, chest, and/or abdomen) were ordered in 74 (52%) of SOC patients. Adding SDCT scanning identified 92% of causes for arrest compared to 75% (SOC-cohort; p value < 0.001) and reduced the time to diagnosis by 78% (SDCT 3.1 hours, SOC alone 14.1 hours, p < 0.0001). Identification of critical diagnoses was similar between cohorts, but SDCT reduced delayed (>6 hours) identification of critical diagnoses by 81% (p < 0.001). SDCT safety endpoints were similar including acute kidney injury. Patient survival to discharge was similar between cohorts. DISCUSSION: SDCT scanning early after OHCA resuscitation safely improved the efficiency and diagnostic yield for causes of arrest compared to the standard of care alone.

**4.** Resuscitation. 2023 Aug;189:109898. doi: 10.1016/j.resuscitation.2023.109898. Epub 2023 Jul 6.

**Diagnostic yield of computed tomography after non-traumatic out-of-hospital cardiac arrest.**

Tam J(1), Soufleris C(2), Ratay C(2), Frisch A(2), Elmer J(3), Case N(2), Flickinger KL(2), Callaway CW(2), Coppler PJ(4); University of Pittsburgh Post-Cardiac Arrest Service.

**ABSTRACT**

AIM: Determine the frequency with which computed tomography (CT) after out-of-hospital cardiac arrest (OHCA) identifies clinically important findings. METHODS: We included non-traumatic OHCA patients treated at a single center from February 2019 to February 2021. Clinical practice was to obtain CT head in comatose patients. Additionally, CT of the cervical spine, chest, abdomen, and pelvis were obtained if clinically indicated. We identified CT imaging obtained within 24 hours of emergency department (ED) arrival and summarized radiology findings. We used descriptive statistics to summarize population characteristics and imaging results, report their frequencies and, post hoc, compared time from ED arrival to catheterization between patients who did and did not undergo CT. RESULTS: We included 597 subjects, of which 491 (82.2%) had a CT obtained. Time to CT was 4.1 hours [2.8-5.7]. Most (n = 480, 80.4%) underwent CT head, of which 36 (7.5%) had intracranial hemorrhage and 161 (33.5%) had cerebral edema. Fewer subjects (230, 38.5%) underwent a cervical spine CT, and 4 (1.7%) had acute vertebral fractures. Most subjects (410, 68.7%) underwent a chest CT, and abdomen and pelvis CT (363, 60.8%). Chest CT abnormalities included rib or sternal fractures (227, 55.4%), pneumothorax (27, 6.6%), aspiration or pneumonia (309, 75.4%), mediastinal hematoma (18, 4.4%) and pulmonary embolism (6, 3.7%). Significant abdomen and pelvis findings were bowel ischemia (24, 6.6%) and solid organ laceration (7, 1.9%). Most subjects that had CT imaging deferred were awake and had shorter time to catheterization. CONCLUSIONS: CT identifies clinically important pathology after OHCA.

**5.** J Clin Med. 2023 Jul 5;12(13):4497. doi: 10.3390/jcm12134497.

**Blood Pressure Targets for Out-of-Hospital Cardiac Arrest: A Systematic Review and Meta-Analysis.**

Lim SL(1)(2)(3), Low CJW(2), Ling RR(2), Sultana R(4), Yang V(5), Ong MEH(6)(7), Chia YW(2)(8)(9), Sharma VK(2)(10), Ramanathan K(2)(11).

**ABSTRACT**

BACKGROUND: With ideal mean arterial pressure (MAP) targets in resuscitated out-of-hospital cardiac arrest (OHCA) patients unknown, we performed a meta-analysis of randomised controlled trials (RCTs) to compare the effects of higher versus lower MAP targets. METHODS: We searched four databases until 1 May 2023 for RCTs reporting the effects of higher MAP targets (>70 mmHg) in resuscitated OHCA patients and conducted random-effects meta-analyses. The primary outcome was mortality while secondary outcomes were neurological evaluations, arrhythmias, acute kidney injury, and durations of mechanical ventilation and ICU stay. We conducted inverse-variance weighted strata-level meta-regression against a proportion of non-survivors to assess differences between reported MAPs. We also conducted a trial sequential analysis of RCTs. RESULTS: Four RCTs were included. Higher MAP was not associated with reduced mortality (OR: 1.09, 95%-CI: 0.84 to 1.42, p = 0.51), or improved neurological outcomes (OR: 0.99, 95%-CI: 0.77 to 1.27, p = 0.92). Such findings were consistent despite additional sensitivity analyses. Our robust variance strata-level meta-regression revealed no significant associations between mean MAP and the proportion of non-survivors (B: 0.029, 95%-CI: -0.023 to 0.081, p = 0.162), and trial sequential analysis revealed no meaningful survival benefit for higher MAPs. CONCLUSIONS: A higher MAP target was not significantly associated with improved mortality and neurological outcomes in resuscitated OHCA patients.

**6.** Diagnostics (Basel). 2023 Jun 26;13(13):2174. doi: 10.3390/diagnostics13132174.

**Preliminary Prognostication for Good Neurological Outcomes in the Early Stage of Post-Cardiac Arrest Care.**

Lee S(1), Park JS(1)(2), You Y(1), Min JH(2)(3), Jeong W(1)(2), Ahn HJ(1)(2), In YN(2)(3), Cho YC(1), Lee IH(4)(5), Lee JK(6), Kang C(1)(2).

**ABSTRACT**

We investigated prognostic strategies for predicting good outcomes in the early stage of post-cardiac-arrest care using multiple prognostic tests that are available until 24 h after the return of spontaneous circulation (ROSC). A retrospective analysis was conducted on 138 out-of-hospital cardiac-arrest patients who underwent prognostic tests, including the gray-white-matter ratio (GWR-BG), the Glasgow Coma Scale motor (GCS-M) score before sedative administration, and the neuron-specific enolase (NSE) level measured at 24 h after the ROSC. We investigated the prognostic performances of the tests as single predictors and in various combination strategies. Classification and regression-tree analysis were used to provide a reliable model for the risk stratification. Out of all the patients, 55 (44.0%) had good outcomes. The NSE level showed the highest prognostic performance as a single prognostic test and provided improved specificities (>70%) and sensitivities (>98%) when used in combination strategies. Low NSE levels (≤32.1 ng/mL) and high GCS-M (≥4) scores identified good outcomes without misclassification. The overall accuracy for good outcomes was 81.8%. In comatose patients with low NSE levels or high GCS-M scores, the premature withdrawal of life-sustaining therapy should be avoided, thereby complying with the formal prognostication-strategy algorithm after at least 72 h from the ROSC.

**7.** Acad Emerg Med. 2023 Jul 9. doi: 10.1111/acem.14774. Online ahead of print.

**Early versus delayed coronary angiography after out-of-hospital cardiac arrest without ST-segment elevation.**

Davila E(1), Chirayil J(1), Silverberg M(1).

**NO ABSTRACT AVAILABLE**

**8.** Am J Emerg Med. 2023 Jul 13;72:27-33. doi: 10.1016/j.ajem.2023.07.015. Online ahead of print.

**Association between post-cardiac arrest treatments and clinical outcomes according to scene time interval in out-of-hospital cardiac arrest: Retrospective cross-sectional study.**
Jung E(1), Ryu HH(2), Ro YS(3), Shin SD(4).
**ABSTRACT**
BACKGROUND: Previous studies have reported that Post-Cardiac arrest (PCA) treatments including targeted temperature management (TTM), coronary reperfusion therapy (CRT), and extracorporeal membrane oxygenation (ECMO) are time-sensitive; however, there are no reports of the clinical outcomes of PCA treatment according to the scene time interval (STI). Our study aimed to investigated the clinical outcomes of PCA treatment according to the STI. METHODS: We used a Korean nationwide OHCA cohort database from January 2017 to December 2020. The inclusion criteria were all adult OHCA patients with a presumed cardiac etiology, bystander-witnessed arrest, and prehospital return of spontaneous circulation (ROSC). The outcomes were survival to discharge and good neurological recovery. The main exposure of interest was PCA treatment. We compared the outcomes using multivariable logistic regression, and interaction terms were included in the final model to assess whether the STI modified the effect of PCA treatment on clinical outcomes of OHCA. RESULTS: TTM and CRT were associated with high survival to discharge and good neurological recovery. In the interaction analysis, ECMO had an interaction effect with the STI on a good CPC among patients with OHCA [short STI (0 to 11 min) (1.16 (0.77-1.75)), middle STI (12 to 15 min) (0.66 (0.41-1.06)), and long STI (16 to 30 min) (0.59 (0.40-0.88)) (p for interaction <0.05)]. CONCLUSION: In adult bystander-witnessed patients with OHCA with prehospital ROSC, an STI of >16 min was a risk factor for poor neurological outcome in those patients who underwent ECMO.

**9.** Eur Heart J Acute Cardiovasc Care. 2023 Jul 18:zuad077. doi: 10.1093/ehjacc/zuad077. Online ahead of print.
**Hemodynamic, Oxygenation, and Ventilation Targets after Cardiac Arrest: the current ABC of post cardiac arrest intensive care.**
Kjaergaard J(1)(2), Møller JE(1)(3).
**ABSTRACT**
Post cardiac arrest care has been significantly improved over the past two decades following the publication of the two trials in therapeutic hypothermia, later renamed to targeted temperature management (TTM). While the initial research and treatment guidelines focussed in lowering core temperature, guidelines recommend more treatment goals, some of which are based in very limited evidence. The review seeks to describe the current evidence levels in the guidelines recommended targets for post resuscitation care, and to suggest treatment targets that includes the newest and best available evidence.

**10.** J Crit Care. 2023 Jul 27;78:154365. doi: 10.1016/j.jcrc.2023.154365. Online ahead of print.
**High versus low mean arterial pressure targets after out-of-hospital cardiac arrest: A systematic review and meta-analysis of randomized controlled trials.**
Abuelazm M(1), Ali S(2), Mahmoud A(3), Mechi A(4), Kadhim H(5), Katamesh BE(6), Elzeftawy MA(7), Ibrahim AA(8), Abdelazeem B(9).
**ABSTRACT**
BACKGROUND: Targeting a specific mean arterial pressure (MAP) has been evaluated as a treatment strategy after out-of-hospital cardiac arrest (OHCA) resuscitation. However, the current evidence lacks clear guidelines regarding the optimal MAP target after OHCA. METHODS: A systematic review and meta-analysis synthesizing randomized controlled trials (RCTs), retrieved by systematically searching: PubMed, EMBASE, WOS, SCOPUS, and Cochrane through January 18th, 2023. Our review protocol was prospectively published on PROSPERO with ID: CRD42023395333. RESULTS: Four RCTs with a total of 1065 patients were included in our analysis. There was no difference between high MAP versus low MAP regarding the primary outcomes: all-cause mortality (RR: 1.07 with a 95% CI [0.91, 1.27], P = 0.4) and favorable neurological recovery (RR: 1.02 with a 95% CI [0.93, 1.13],

P = 0.68). However, high MAP target was significantly associated with decreased ICU stay duration (MD: -0.78 with a 95 CI [-1.54, -0.02], P = 0.04) and mechanical ventilation duration (MD: -0.91 with a 95 CI of [-1.51, -0.31], P = 0.003). CONCLUSION: A high MAP target may reduce ICU stay and mechanical ventilation duration but did not demonstrate improvements in either mortality or favorable neurological recovery. Therefore, the role of high MAP target remains uncertain and requires further RCTs.

**11.** J Clin Med. 2023 Jul 9;12(14):4568. doi: 10.3390/jcm12144568.
**Comparison of Prognostic Performance between Procalcitonin and Procalcitonin-to-Albumin Ratio in Post Cardiac Arrest Syndrome.**
Yoon JH(1), Choi WS(1), Lim YS(2), Jang JH(2).
**ABSTRACT**
(1) Background: Post-cardiac arrest syndrome (PCAS) is a type of global ischemic reperfusion injury that occurs after the return of spontaneous circulation (ROSC). The procalcitonin to albumin ratio (PAR) has been studied as an independent prognostic factor of various diseases. There are no previous studies of PAR in patients with PCAS. We assessed if PAR is more effective than procalcitonin (PCT) in predicting prognosis for patients with PCAS. (2) Methods: This retrospective cohort study included a total of 187 patients with PCAS after non-traumatic out-of-hospital cardiac arrest (OHCA) between January 2016 and December 2020. Multivariate logistic regression analysis was conducted to assess the association between PAR and PCAS prognosis. The predictive performance of PAR was compared with PCT via the receiver-operating characteristic (ROC) analysis and DeLong test.; (3) Results: PAR at 24 and 48 h after hospital admission were independently associated with one-month neurological outcome (OR: 1.167, 95% CI: 1.023-1.330; OR: 1.077, 95% CI: 1.012-1.146, $p < 0.05$). By ROC analysis, PAR showed better performance over PCT at 48 h after admission in predicting one-month CPC (0.763 vs. 0.772, $p = 0.010$). (4) Conclusions: Our findings suggest that PAR at 48 h after admission is more effective in predicting a one-month neurological outcome than PCT at 48 h after admission in patients with PCAS after OHCA.

**12.** Intensive Care Med. 2023 Jul 28. doi: 10.1007/s00134-023-07165-x. Online ahead of print.
**Clinical targeting of the cerebral oxygen cascade to improve brain oxygenation in patients with hypoxic-ischaemic brain injury after cardiac arrest.**
Hoiland RL(1)(2)(3)(4)(5), Robba C(6)(7), Menon DK(8), Citerio G(9), Sandroni C(#)(10), Sekhon MS(#)(11)(12)(13)(14).
**ABSTRACT**
The cerebral oxygen cascade includes three key stages: (a) convective oxygen delivery representing the bulk flow of oxygen to the cerebral vascular bed; (b) diffusion of oxygen from the blood into brain tissue; and (c) cellular utilisation of oxygen for aerobic metabolism. All three stages may become dysfunctional after resuscitation from cardiac arrest and contribute to hypoxic-ischaemic brain injury (HIBI). Improving convective cerebral oxygen delivery by optimising cerebral blood flow has been widely investigated as a strategy to mitigate HIBI. However, clinical trials aimed at optimising convective oxygen delivery have yielded neutral results. Advances in the understanding of HIBI pathophysiology suggest that impairments in the stages of the oxygen cascade pertaining to oxygen diffusion and cellular utilisation of oxygen should also be considered in identifying therapeutic strategies for the clinical management of HIBI patients. Culprit mechanisms for these impairments may include a widening of the diffusion barrier due to peri-vascular oedema and mitochondrial dysfunction. An integrated approach encompassing both intra-parenchymal and non-invasive neuromonitoring techniques may aid in detecting pathophysiologic changes in the oxygen cascade and enable patient-specific management aimed at reducing the severity of HIBI.

**13.** Clin Res Cardiol. 2023 Jul 27. doi: 10.1007/s00392-023-02264-7. Online ahead of print.

**Early versus delayed coronary angiography in patients with out-of-hospital cardiac arrest and no ST-segment elevation: a systematic review and meta-analysis of randomized controlled trials.**
Hamidi F(1), Anwari E(1), Spaulding C(2), Hauw-Berlemont C(3), Vilfaillot A(4), Viana-Tejedor A(5), Kern KB(6), Hsu CH(6), Bergmark BA(7), Qamar A(8), Bhatt DL(9), Furtado RHM(10)(11), Myhre PL(12), Hengstenberg C(1), Lang IM(1), Frey N(13)(14), Freund A(15), Desch S(15), Thiele H(15), Preusch MR(#)(16)(17), Zelniker TA(#)(18)(19).

**ABSTRACT**
BACKGROUND: Recent randomized controlled trials did not show benefit of early/immediate coronary angiography (CAG) over a delayed/selective strategy in patients with out-of-hospital cardiac arrest (OHCA) and no ST-segment elevation. However, whether selected subgroups, specifically those with a high pretest probability of coronary artery disease may benefit from early CAG remains unclear. METHODS: We included all randomized controlled trials that compared a strategy of early/immediate versus delayed/selective CAG in OHCA patients and no ST elevation and had a follow-up of at least 30 days. The primary outcome of interest was all-cause death. Odds ratios (OR) were calculated and pooled across trials. Interaction testing was used to assess for heterogeneity of treatment effects. RESULTS: In total, 1512 patients (67 years, 26% female, 23% prior myocardial infarction) were included from 5 randomized controlled trials. Early/immediate versus delayed/selective CAG was not associated with a statistically significant difference in odds of death (OR 1.12, 95%-CI 0.91-1.38), with similar findings for the composite outcome of all-cause death or neurological deficit (OR 1.10, 95%-CI 0.89-1.36). There was no effect modification for death by age, presence of a shockable initial cardiac rhythm, history of coronary artery disease, presence of an ischemic event as the presumed cause of arrest, or time to return of spontaneous circulation (all P-interaction > 0.10). However, early/immediate CAG tended to be associated with higher odds of death in women (OR 1.52, 95%-CI 1.00-2.31, P = 0.050) than in men (OR 1.04, 95%-CI 0.82-1.33, P = 0.74; P-interaction 0.097). CONCLUSION: In OHCA patients without ST-segment elevation, a strategy of early/immediate versus delayed/selective CAG did not reduce all-cause mortality across major subgroups. However, women tended to have higher odds of death with early CAG.

**14.** Prehosp Emerg Care. 2023 Jul 26:1-9. doi: 10.1080/10903127.2023.2238820. Online ahead of print.

**The Association of Combined Prehospital Hypotension and Hypoxia With Outcomes Following Out-of-Hospital Cardiac Arrest Resuscitation.**
Smida T(1), Menegazzi JJ(2), Crowe RP(3), Salcido D(2), Martin PS(4), Scheidler J(4), James Bardes(4)(5).

**ABSTRACT**
BACKGROUND: Prehospital post-resuscitation hypotension and hypoxia have been associated with adverse outcomes in the context of out-of-hospital cardiac arrest (OHCA). We aimed to investigate the association between clinical outcomes and post-resuscitation hypoxia alone, hypotension alone, and combined hypoxia and hypotension. METHODS: We used the 2018-2021 ESO annual datasets to conduct this study. All EMS-treated non-traumatic OHCA patients who had a documented prehospital return of spontaneous circulation (ROSC) and two or more SpO2 readings and systolic blood pressures recorded were evaluated for inclusion. Patients who were less than 18 years of age, pregnant, had a do-not-resuscitate order or similar, achieved ROSC after bystander CPR only, or had an EMS-witnessed cardiac arrest were excluded. Multivariable logistic regression adjusted for standard Utstein factors and highest prehospital Glasgow Coma Scale (GCS) score was used to investigate the association between hypoxia, hypotension, and outcomes. RESULTS: We analyzed data for 17,943 patients, of whom 3,979 had hospital disposition data. Hypotension and hypoxia were not documented in 1,343 (33.8%) patients, 1,144 (28.8%) had only hypoxia documented, 507 (12.7%) had only hypotension documented, and 985 (24.8%) had both hypoxia and hypotension documented. In comparison to patients who did not have documented hypotension or hypoxia, patients who had documented hypoxia (aOR: 1.76 [1.38, 2.24]), documented hypotension (aOR: 3.00

[2.15, 4.18]), and documented hypoxia and hypotension combined (aOR: 4.87 [3.63, 6.53]) had significantly increased mortality. The relationship between mortality and vital sign abnormalities (hypoxia and hypotension > hypotension > hypoxia) was observed in every evaluated subgroup. CONCLUSIONS: In this large dataset, hypotension and hypoxia were independently associated with mortality both alone and in combination. Compared to patients without documented hypotension and hypoxia, patients with documented hypotension and hypoxia had nearly five-fold greater odds of mortality.

**15.** Eur Heart J Acute Cardiovasc Care. 2023 Jul 24:zuad086. doi: 10.1093/ehjacc/zuad086. Online ahead of print.

**Diagnosis and management of seizures and myoclonus after cardiac arrest.**

Horn J(1)(2), Admiraal MM(2)(3), Hofmeijer J(4)(5).

**ABSTRACT**

Cardiac arrest may lead to postanoxic brain injury. In approximately one third of the patients who remain in coma, myoclonus or status myoclonus is seen. Clinically manifest or electrographic epileptic seizures or status epilepticus are less common. Both status myoclonus and electrographic seizures indicate severe brain injury. Electroencephalography can contribute to discrimination between epileptic seizures and postanoxic myoclonus, as well as to identification of patients that may have a good outcome or can benefit from treatment. Accumulating data suggest that extensive anti-seizure treatment is futile in case of general periodic discharges. On the other hand, the small subgroup of patients with EEG patterns closely resembling electrographic seizures or status epilepticus may benefit from anti-seizure treatment, but the evidence of efficacy is weak. Medication to suppress clinically manifest myoclonus may be necessary for general ICU care and mechanical ventilation, but does not improve a patient's prognosis.

## ELECTROPHYSIOLOGY AND DEFIBRILLATION

**1.** Resuscitation. 2023 Jul 7;190:109902. doi: 10.1016/j.resuscitation.2023.109902. Online ahead of print.

**Racial and ethnic disparities amongst patients with lay rescuer automated external defibrillator placement after out-of-hospital cardiac arrest.**

Toy J(1).

**ABSTRACT**

OBJECTIVE: This study evaluated the association between patient race/ethnicity and the odds of AED provision by a lay rescuer in out-of-hospital cardiac arrest (OHCA) in the United States. METHODS: This was a cross-sectional retrospective study of OHCA patients in the National Emergency Medical Services Information System database from the year 2021. Patients were excluded for age < 18 years, EMS-witnessed arrest, traumatic arrest, arrest in a healthcare setting, do-not-resuscitate order, and arrest in a wilderness location. The primary outcome was the association between race/ethnicity and the odds of lay-rescuer AED placement for OHCA. Multiple logistic regression adjusting for known covariates was performed and odds ratios were reported. RESULTS: A total of 207,134 patients were included. Patients with lay rescuer AED use had statistically significant differences with regard to arrest location and arrest witnessed status, and had longer EMS response times (8.5 minutes vs 7 minutes). The odds of AED use was lowest for American Indian/Alaskan Native persons (OR 0.62; 95% CI 0.54, 0.72) followed by Asian (OR 0.66; 95% CI 0.60, 0.72), Hispanic (OR 0.66; 95% CI 0.63, 0.69) and Native Hawaiian/Pacific Islander patients (OR 0.69; 95% CI 0.57, 0.83) when compared to White patients. Black patients had the highest odds of AED use (OR 1.10; 95% CI 1.07, 1.12). CONCLUSION: When compared to White persons, the odds of lay rescuer AED use

in OHCA was between 31-38% lower for American Indian/Alaskan Native, Asian, Hispanic, and Native Hawaiian/Pacific Islander persons, and 10% higher for Black persons.

**2.** World J Emerg Med. 2023;14(4):265-272. doi: 10.5847/wjem.j.1920-8642.2023.070.
**Effect of a low-cost instruction card for automated external defibrillator operation in lay rescuers: a randomized simulation study.**
Zhou Q(1), Dong X(2), Zhang W(3), Wu R(1), Chen K(1), Zhang H(1), Zheng Z(2), Zhang L(4)(5).
**ABSTRACT**
BACKGROUND: To evaluate whether a simplified self-instruction card can help potential rescue providers use automated external defibrillators (AEDs) more accurately and quickly. METHODS: From June 1, 2018, to November 30, 2019, a prospective longitudinal randomized controlled simulation study was conducted among 165 laypeople (18-65 years old) without prior AED training. A self-instruction card was designed to illuminate key AED operation procedures. Subjects were randomly divided into the card (n=83) and control (n=82) groups with age stratification. They were then individually evaluated in the same simulated scenario to use AED with (card group) or without the self-instruction card (control group) at baseline, post-training, and at the 3-month follow-up. RESULTS: At baseline, the card group reached a significantly higher proportion of successful defibrillation (31.1% vs. 15.9%, P=0.03), fully baring the chest (88.9% vs. 63.4%, P<0.001), correct electrode placement (32.5% vs. 17.1%, P=0.03), and resuming cardiopulmonary resuscitation (CPR) (72.3% vs. 9.8%, P<0.001). At post-training and follow-up, there were no significant differences in key behaviors, except for resuming CPR. Time to shock and time to resume CPR were shorter in the card group, while time to power-on AED was not different in each phase of tests. In the 55-65 years group, the card group achieved more skill improvements over the control group compared to the other age groups. CONCLUSION: The self-instruction card could serve as a direction for first-time AED users and as a reminder for trained subjects. This could be a practical, cost-effective way to improve the AED skills of potential rescue providers among different age groups, including seniors.

**3.** Front Neurol. 2023 Jul 4;14:1210491. doi: 10.3389/fneur.2023.1210491. eCollection 2023.
**Electrocardiogram monitoring as a predictor of neurological and survival outcomes in patients with out-of-hospital cardiac arrest: a single-center retrospective observational study.**
Takahashi M(1), Ogura K(2), Goto T(2), Hayakawa M(1).
**ABSTRACT**
INTRODUCTION: This study hypothesized that monitoring electrocardiogram (ECG) waveforms in patients with out-of-hospital cardiac arrest (OHCA) could have predictive value for survival or neurological outcomes. We aimed to establish a new prognostication model based on the single variable of monitoring ECG waveforms in patients with OHCA using machine learning (ML) techniques. METHODS: This observational retrospective study included successfully resuscitated patients with OHCA aged ≥ 18 years admitted to an intensive care unit in Japan between April 2010 and April 2020. Waveforms from ECG monitoring for 1 h after admission were obtained from medical records and examined. Based on the open-access PTB-XL dataset, a large publicly available 12-lead ECG waveform dataset, we built an ML-supported premodel that transformed the II-lead waveforms of the monitoring ECG into diagnostic labels. The ECG diagnostic labels of the patients in this study were analyzed for prognosis using another model supported by ML. The endpoints were favorable neurological outcomes (cerebral performance category 1 or 2) and survival to hospital discharge. RESULTS: In total, 590 patients with OHCA were included in this study and randomly divided into 3 groups (training set, n = 283; validation set, n = 70; and test set, n = 237). In the test set, our ML model predicted neurological and survival outcomes, with the highest areas under the receiver operating characteristic curves of 0.688 (95% CI: 0.682-0.694) and 0.684 (95% CI: 0.680-

0.689), respectively. CONCLUSION: Our ML predictive model showed that monitoring ECG waveforms soon after resuscitation could predict neurological and survival outcomes in patients with OHCA.

**4.** Brain Commun. 2023 Jun 28;5(4):fcad190. doi: 10.1093/braincomms/fcad190. eCollection 2023.
**The effect of sedation and time after cardiac arrest on coma outcome prognostication based on EEG power spectra.**
Pelentritou A(1), Nguissi NAN(1), Iten M(2), Haenggi M(2), Zubler F(3), Rossetti AO(4), De Lucia M(1).
**ABSTRACT**
Early prognostication of long-term outcome of comatose patients after cardiac arrest remains challenging. Electroencephalography-based power spectra after cardiac arrest have been shown to help with the identification of patients with favourable outcome during the first day of coma. Here, we aim at comparing the power spectra prognostic value during the first and second day after coma onset following cardiac arrest and to investigate the impact of sedation on prognostication. In this cohort observational study, we included comatose patients (N = 91) after cardiac arrest for whom resting-state electroencephalography was collected on the first and second day after cardiac arrest in four Swiss hospitals. We evaluated whether the average power spectra values at 4.6-15.2 Hz were predictive of patients' outcome based on the best cerebral performance category score at 3 months, with scores ranging from 1 to 5 and dichotomized as favourable (1-2) and unfavourable (3-5). We assessed the effect of sedation and its interaction with the electroencephalography-based power spectra on patient outcome prediction through a generalized linear mixed model. Power spectra values provided 100% positive predictive value (95% confidence intervals: 0.81-1.00) on the first day of coma, with correctly predicted 18 out of 45 favourable outcome patients. On the second day, power spectra values were not predictive of patients' outcome (positive predictive value: 0.46, 95% confidence intervals: 0.19-0.75). On the first day, we did not find evidence of any significant contribution of sedative infusion rates to the patient outcome prediction ($P > 0.05$). Comatose patients' outcome prediction based on electroencephalographic power spectra is higher on the first compared with the second day after cardiac arrest. Sedation does not appear to impact patient outcome prediction.

**5.** Neurocrit Care. 2023 Jul 27. doi: 10.1007/s12028-023-01791-5. Online ahead of print.
**Delayed Deterioration of Electroencephalogram in Patients with Cardiac Arrest: A Cohort Study.**
Peluso L(1)(2)(3), Stropeni S(4), Macchini E(4), Peratoner C(4), Ferlini L(5), Legros B(5), Minini A(4), Bogossian EG(4), Garone A(4), Creteur J(4), Taccone FS(4), Gaspard N(5)(6).
**ABSTRACT**
BACKGROUND: The aim of this study was to assess the prevalence of delayed deterioration of electroencephalogram (EEG) in patients with cardiac arrest (CA) without early highly malignant patterns and to determine their associations with clinical findings. METHODS: This was a retrospective study of adult patients with CA admitted to the intensive care unit (ICU) of a university hospital. We included all patients with CA who had a normal voltage EEG, no more than 10% discontinuity, and absence of sporadic epileptic discharges, periodic discharges, or electrographic seizures. Delayed deterioration was classified as the following: (1) epileptic deterioration, defined as the appearance, at least 24 h after CA, of sporadic epileptic discharges, periodic discharges, and status epilepticus; or (2) background deterioration, defined as increasing discontinuity or progressive attenuation of the background at least 24 h after CA. The end points were the incidence of EEG deteriorations and their association with clinical features and ICU mortality. RESULTS: We enrolled 188 patients in the analysis. The ICU mortality was 46%. Overall, 30 (16%) patients presented with epileptic deterioration and 9 (5%) patients presented with background deterioration; of those, two

patients presented both deteriorations. Patients with epileptic deterioration more frequently had an out-of-hospital CA, and higher time to return of spontaneous circulation and less frequently had bystander resuscitation than others. Patients with background deterioration showed a predominantly noncardiac cause, more frequently developed shock, and had multiple organ failure compared with others. Patients with epileptic deterioration presented with a higher ICU mortality (77% vs. 41%; $p < 0.01$) than others, whereas all patients with background deterioration died in the ICU. CONCLUSIONS: Delayed EEG deterioration was associated with high mortality rate. Epileptic deterioration was associated with worse characteristics of CA, whereas background deterioration was associated with shock and multiple organ failure.

**6.** Clin Neurophysiol. 2023 Jul 14;153:141-151. doi: 10.1016/j.clinph.2023.06.020. Online ahead of print.

**Enhanced analysis of somatosensory evoked potentials at 20-30 milliseconds can predict neurological outcome after cardiac arrest.**

Gourd NM(1), Bigham C(2), Broomfield N(3), Nye L(3), Stapleton L(2), Stead E(3), Smith A(3), Baker A(4), Chynoweth J(4), Hosking J(4), Hudson N(3), Nikitas N(5).

**ABSTRACT**

OBJECTIVE: This study attempted to test the effectiveness of an enhanced analysis of the 20-30 ms complex of somatosensory evoked potentials, in predicting the short-term outcome of comatose survivors of out of hospital cardiac arrest and compare it with the current clinical practice. METHODS: Single-centre, prospective, observational study. Median nerve SSEP recording performed at 24-36 h post-return of spontaneous circulation. Recording was analysed using amplitude measurements of P25/30 and Peak-To-Trough of 20-30 ms complex and thresholds to decide P25/30 presence. Neurological outcome was dichotomised into favourable and unfavourable. RESULTS: 89 participants were analysed. 43.8% had favourable and 56.2% unfavourable outcome. The sensitivity, specificity, positive and negative predictive values of the present SSEP and favourable outcome were calculated. P25/30 presence and size of PTT improved positive predictive value and specificity, while maintained similar negative predictive value and sensitivity, compared to the current practice. Inter-interpreter agreement was also improved. CONCLUSIONS: Enhanced analysis of the SSEP at 20-30 ms complex could improve the short-term prognostic accuracy for short-term neurological outcome in comatose survivors of cardiac arrest. SIGNIFICANCE: Peak-To-Trough analysis of the 20-30 ms SSEP waveform appears to be the best predictor of neurological outcome following out of hospital cardiac arrest. It is also the easiest and most reliable to analyse.

**7.** Ann Noninvasive Electrocardiol. 2023 Jul 22:e13075. doi: 10.1111/anec.13075. Online ahead of print.

**Defibrillation strategies for refractory ventricular fibrillation out-of-hospital cardiac arrest: A systematic review and network meta-analysis.**

Abuelazm MT(1), Ghanem A(2), Katamesh BE(1), Hassan AR(1), Abdalshafy H(3), Seri AR(4)(5), Awad AK(6), Abdelnabi M(7), Abdelazeem B(4)(5).

**ABSTRACT**

BACKGROUND AND OBJECTIVE: Double sequential external defibrillation (DSED) and vector-change defibrillation (VCD) have been suggested to enhance clinical outcomes for patients with ventricular fibrillation (VF) refractory of standard defibrillation (SD). Therefore, this network meta-analysis aims to evaluate the comparative efficacy of DSED, VCD, and SD for refractory VF. METHODS: A systematic review and network meta-analysis synthesizing randomized controlled trials (RCTs) and comparative observational studies retrieved from PubMed, EMBASE, WOS, SCOPUS, and Cochrane

through November 15th, 2022. R software netmeta and netrank package (R version 4.2.0) and meta-insight software were used to pool dichotomous outcomes using odds ratio (OR) presented with the corresponding confidence interval (CI). Our protocol was prospectively published in PROSPERO with ID: CRD42022378533. RESULTS: We included seven studies with a total of 1632 participants. DSED was similar to SD in survival to hospital discharge (OR: 1.14 with 95% CI [0.55, 2.83]), favorable neurological outcome (modified Rankin scale ≤2 or cerebral performance category ≤2) (OR: 1.35 with 95% CI [0.46, 3.99]), and return of spontaneous circulation (ROSC) (OR: 0.81 with 95% CI [0.43; 1.5]). In addition, VCD was similar to SD in survival to hospital discharge (OR: 1.12 with 95% CI [0.27, 4.57]), favorable neurological outcome (OR: 1.01 with 95% CI [0.18, 5.75]), and ROSC (OR: 0.88 with 95% CI [0.24; 3.15]). CONCLUSION: Double sequential external defibrillation and VCD were not associated with enhanced outcomes in patients with refractory VF out-of-hospital cardiac arrest, compared to SD. However, the current evidence is still inconclusive, warranting further large-scale RCTs.

**8.** Resuscitation. 2023 Aug;189:109891. doi: 10.1016/j.resuscitation.2023.109891. Epub 2023 Jun 28.
**Age, sex, and survival following ventricular fibrillation cardiac arrest: A mechanistic evaluation of the ECG waveform.**
Yang BY(1), Coult J(2), Blackwood J(3), Kwok H(4), Rajah A(2), Goldenberg I(5), Sotoodehenia N(6), Harris JR(7), Kudenchuk PJ(8), Rea TD(9).
**ABSTRACT**
BACKGROUND: Studies of outcome differences by sex in out-of-hospital cardiac arrest (OHCA) have produced mixed results that may depend on age, a potential surrogate for menopausal status. OBJECTIVE: We used quantitative measures of ventricular fibrillation (VF) waveforms - indicators of the myocardium's physiology - to assess whether survival differences according to sex and age group may be mediated via a biologic mechanism. METHODS: We conducted a cohort study of VF-OHCA in a metropolitan EMS system. We used multivariable logistic regression to assess the association of survival to hospital discharge with sex and age group (<55, ≥55 years). We determined the proportion of outcome difference mediated by VF waveform measures: VitalityScore and amplitude spectrum area (AMSA). RESULTS: Among 1526 VF-OHCA patients, the average age was 62 years, and 29% were female. Overall, younger women were more likely to survive than younger men (survival 67% vs 54%, p = 0.02), while survival among older women and older men did not differ (40% vs 44%, p = 0.3). Adjusting for Utstein characteristics, women <55 compared to men <55 had greater odds of survival to hospital discharge (OR = 1.93, 95% CI 1.23-3.09), an association not observed between the ≥55 groups. Waveform measures were more favorable among women and mediated some of the beneficial association between female sex and survival among those <55 years: 47% for VitalityScore and 25% for AMSA. CONCLUSIONS: Women <55 years were more likely to survive than men <55 years following VF-OHCA. The biologic mechanism represented by VF waveform mediated some, though not all, of the outcome difference.

## TARGETED TEMPERATURE MANAGEMENT

**1.** J Cereb Blood Flow Metab. 2023 Jun 28:271678X231185658. doi: 10.1177/0271678X231185658. Online ahead of print.
**Association between time-dependent changes in cerebrovascular autoregulation after cardiac arrest and outcomes: A prospective cohort study.**
Tachino J(1), Nonomiya Y(2), Taniuchi S(2), Shintani A(2), Nakao S(1), Takegawa R(3)(4), Hirose T(1), Sakai T(1), Ohnishi M(5), Shimazu T(6), Shiozaki T(1).
**ABSTRACT**

This prospective observational single-center cohort study aimed to determine an association between cerebrovascular autoregulation (CVAR) and outcomes in hypoxic-ischemic brain injury post-cardiac arrest (CA), and assessed 100 consecutive post-CA patients in Japan between June 2017 and May 2020 who experienced a return of spontaneous circulation. Continuous monitoring was performed for 96 h to determine CVAR presence. A moving Pearson correlation coefficient was calculated from the mean arterial pressure and cerebral regional oxygen saturation. The association between CVAR and outcomes was evaluated using the Cox proportional hazard model; non-CVAR time percent was the time-dependent, age-adjusted covariate. The non-linear effect of target temperature management (TTM) was assessed using a restricted cubic spline. Of the 100 participants, CVAR was detected using the cerebral performance category (CPC) in all patients with a good neurological outcome (CPC 1-2) and in 65 patients (88%) with a poor outcome (CPC 3-5). Survival probability decreased significantly with increasing non-CVAR time percent. The TTM versus the non-TTM group had a significantly lower probability of a poor neurological outcome at 6 months with a non-CVAR time of 18%-37% ($p < 0.05$). Longer non-CVAR time may be associated with significantly increased mortality in hypoxic-ischemic brain injury post-CA.

**2.** Resuscitation. 2023 Jul;188:109841. doi: 10.1016/j.resuscitation.2023.109841. Epub 2023 May 15.
**Implementing a strict fever control protocol for resuscitated cardiac arrest patients.**
Coppler PJ(1).
**NO ABSTRACT AVAILEBLE**

**3.** Resuscitation. 2023 Jul;188:109796. doi: 10.1016/j.resuscitation.2023.109796. Epub 2023 Apr 12.
**Change of target temperature from 36 °C to strict fever avoidance only in comatose cardiac arrest survivors - A before and after study.**
Tirkkonen J(1), Skrifvars MB(2).
**ABSTRACT**
AIM: The guidelines on temperature control for comatose cardiac arrest survivors were recently changed from recommending targeted temperature management (32-36 °C) to fever control (≤37.7 °C). We investigated the effect of implementing a strict fever control strategy on prevalence of fever, protocol adherence, and patient outcome in a Finnish tertiary academic hospital. METHODS: Comatose cardiac arrest survivors treated with either mild device-controlled therapeutic hypothermia (≤36 °C, years 2020-2021) or strict fever control (≤37 °C, year 2022) for the first 36 h were included in this before-after cohort study. Good neurological outcome was defined as a cerebral performance category score of 1-2. RESULTS: The cohort consisted of 120 patients (≤36 °C group n = 77, ≤37 °C group n = 43). Cardiac arrest characteristics, severity of illness scores, and intensive care management including oxygenation, ventilation, blood pressure management and lactate remained similar between the groups. The median highest temperatures for the 36 h sedation period were 36.3 °C (≤36 °C group) vs. 37.2 °C (≤37 °C group) ($p < 0.001$). Time of the 36 h sedation period spent >37.7 °C was 0.90% vs. 1.1% ($p = 0.496$). External cooling devices were used in 90% vs. 44% of the patients ($p < 0.001$). Good neurological outcome at 30 days was similar between the groups (47% vs. 44%, $p = 0.787$). In multivariable model the ≤37 °C strategy was not associated with any change in outcome (OR 0.88, 95% CI 0.33-2.3). CONCLUSIONS: The implementation strict fever control strategy was feasible and did not result in increased prevalence of fever, poorer protocol adherence, or worse patient outcomes. Most patients in the fever control group did not require external cooling.

**4.** Am J Emerg Med. 2023 Jun 28;71:182-189. doi: 10.1016/j.ajem.2023.06.040. Online ahead of print.

**Therapeutic hypothermia in patients after cardiac arrest: A systematic review and meta-analysis of randomized controlled trials.**

Chiu PY(1), Chung CC(2), Tu YK(3), Tseng CH(4), Kuan YC(5).

**ABSTRACT**

OBJECTIVE: Targeted temperature management (TTM) with therapeutic hypothermia (TH) has been used to improve neurological outcomes in patients after cardiac arrest; however, several trials have reported conflicting results regarding its effectiveness. This systematic review and meta-analysis assessed whether TH was associated with better survival and neurological outcomes after cardiac arrest. METHOD: We searched online databases for relevant studies published before May 2023. Randomized controlled trials (RCTs) comparing TH and normothermia in post-cardiac-arrest patients were selected. Neurological outcomes and all-cause mortality were assessed as the primary and secondary outcomes, respectively. A subgroup analysis according to initial electrocardiography (ECG) rhythm was performed. RESULT: Nine RCTs (4058 patients) were included. The neurological prognosis was significantly better in patients with an initial shockable rhythm after cardiac arrest (RR = 0.87, 95% confidence interval [CI] = 0.76-0.99, P = 0.04), especially in those with earlier TH initiation (<120 min) and prolonged TH duration (≥24 h). However, the mortality rate after TH was not lower than that after normothermia (RR = 0.91, 95% CI = 0.79-1.05). In patients with an initial nonshockable rhythm, TH did not provide significantly more neurological or survival benefits (RR = 0.98, 95% CI = 0.93-1.03 and RR = 1.00, 95% CI = 0.95-1.05, respectively). CONCLUSION: Current evidence with a moderate level of certainty suggests that TH has potential neurological benefits for patients with an initial shockable rhythm after cardiac arrest, especially in those with faster TH initiation and longer TH maintenance.

**5.** Intensive Care Med Exp. 2023 Jul 17;11(1):43. doi: 10.1186/s40635-023-00528-0.

**Serum proteome profiles in patients treated with targeted temperature management after out-of-hospital cardiac arrest.**

Lileikyte G(1), Bakochi A(2)(3), Ali A(4), Moseby-Knappe M(5), Cronberg T(5), Friberg H(6), Lilja G(5), Levin H(7), Årman F(2), Kjellström S(2), Dankiewicz J(8), Hassager C(9), Malmström J(3), Nielsen N(10).

**ABSTRACT**

BACKGROUND: Definition of temporal serum proteome profiles after out-of-hospital cardiac arrest may identify biological processes associated with severe hypoxia-ischaemia and reperfusion. It may further explore intervention effects for new mechanistic insights, identify candidate prognostic protein biomarkers and potential therapeutic targets. This pilot study aimed to investigate serum proteome profiles from unconscious patients admitted to hospital after out-of-hospital cardiac arrest according to temperature treatment and neurological outcome. METHODS: Serum samples at 24, 48, and 72 h after cardiac arrest at three centres included in the Target Temperature Management after out-of-hospital cardiac arrest trial underwent data-independent acquisition mass spectrometry analysis (DIA-MS) to find changes in serum protein concentrations associated with neurological outcome at 6-month follow-up and targeted temperature management (TTM) at 33 °C as compared to 36 °C. Neurological outcome was defined according to Cerebral Performance Category (CPC) scale as "good" (CPC 1-2, good cerebral performance or moderate disability) or "poor" (CPC 3-5, severe disability, unresponsive wakefulness syndrome, or death). RESULTS: Of 78 included patients [mean age 66 ± 12 years, 62 (80.0%) male], 37 (47.4%) were randomised to TTM at 36 °C. Six-month outcome was poor in 47 (60.3%) patients. The DIA-MS analysis identified and quantified 403 unique human proteins. Differential protein abundance testing comparing poor to good outcome showed 19 elevated proteins in patients with poor outcome (log2-fold change (FC) range 0.28-1.17) and 16 reduced proteins (log2(FC) between - 0.22 and - 0.68), involved in

inflammatory/immune responses and apoptotic signalling pathways for poor outcome and proteolysis for good outcome. Analysis according to level of TTM showed a significant protein abundance difference for six proteins [five elevated proteins in TTM 36 °C (log2(FC) between 0.33 and 0.88), one reduced protein (log2(FC) - 0.6)] mainly involved in inflammatory/immune responses only at 48 h after cardiac arrest. CONCLUSIONS: Serum proteome profiling revealed an increase in inflammatory/immune responses and apoptosis in patients with poor outcome. In patients with good outcome, an increase in proteolysis was observed, whereas TTM-level only had a modest effect on the proteome profiles. Further validation of the differentially abundant proteins in response to neurological outcome is necessary to validate novel biomarker candidates that may predict prognosis after cardiac arrest.

**6.** Crit Care Med. 2023 Aug 1;51(8):e175-e176. doi: 10.1097/CCM.0000000000005867. Epub 2023 Jul 13.

**Safety Concerns in Intravascular Cooling for Targeted Temperature Management After Cardiac Arrest.**

Honore PM(1), Blackman S(2), Perriens E(2), Bousbiat I(2).

**NO ABSTRACT AVAILABLE**

**7.** J Formos Med Assoc. 2023 Aug;122(8):675-689. doi: 10.1016/j.jfma.2022.11.007. Epub 2022 Dec 6.

**Comparison of outcomes between cardiogenic and non-cardiogenic cardiac arrest patients receiving targeted temperature management: The nationwide TIMECARD multicenter registry.**

Wang MT(1), Tsai MS(2), Huang CH(2), Kuo LK(3), Hsu H(4), Lai CH(5), Chang Lin K(6), Huang WC(7).

**ABSTRACT**

BACKGROUND AND PURPOSE: Targeted temperature management (TTM) has been recommended for post-resuscitation care of cardiac arrest (CA) patients who remain comatose. However, the differences between cardiogenic and non-cardiogenic causes need further investigation. Thus, this study aimed to investigate the difference in outcomes between cardiogenic and non-cardiogenic CA patients receiving TTM. METHODS: The TIMECARD registry established the study cohort and database for patients receiving TTM between January 2013 and September 2019. A total of 543 patients were enrolled, with 305 and 238 patients in the cardiogenic and non-cardiogenic groups, respectively. RESULTS: Compared with the non-cardiogenic group, the cardiogenic group had higher proportion of initial shockable rhythm, better survival (cardiogenic: 45.9%; non-cardiogenic: 30.7%, P = 0.0017), and better neurologic performance at discharge. In the cardiogenic group, witnessed collapse (OR = 0.31, 95% CI: 0.13-0.72), and coronary intervention (OR = 0.45, 95% CI: 0.24-0.84) were positive predictors for overall outcome. Mean arterial pressure <65 mmHg led to poor outcome regardless in the cardiogenic (OR = 3.31, 95% CI: 1.46-7.52) or non-cardiogenic group (OR = 2.39, 95% CI: 1.06-5.39). CONCLUSION: Patients with cardiogenic CA post TTM had better survival and neurologic performance at discharge than those without cardiogenic CA. Cardiogenic etiology was a potential predictor of better cardiac arrest survival, but it was not an independent risk factor for overall outcome after adjusting for potential covariates. In the cardiogenic group, better outcomes were reported in patients with witnessed collapse, bystander cardiopulmonary resuscitation, as well as those receiving coronary intervention.

**8.** J Chin Med Assoc. 2023 Jul 1;86(7):672-681. doi: 10.1097/JCMA.0000000000000939. Epub 2023 Jul 5.

**Impact of a targeted temperature management quality improvement project on survival and neurologic outcomes in cardiac arrest patients.**

Hsu TH(1), Huang WC(2)(3), Lin KC(2), Huang CL(4), Tai HY(5), Tsai YC(5), Wu MC(2), Chang YT(1)(6)(7)(8).

**ABSTRACT**

BACKGROUND: Targeted temperature management (TTM) is recommended for postresuscitation care of patients with sudden cardiac arrest (SCA) and its implementation remains challenging. This study aimed to evaluate the newly designed Quality Improvement Project (QIP) to improve the quality of TTM and outcomes of patients with SCA. METHODS: Patients who experienced out-of-hospital cardiac arrest (OHCA) and in-hospital cardiac arrest (IHCA) with return of spontaneous circulation (ROSC) and were treated in our hospital between January 2017 and December 2019 were enrolled retrospectively. All included patients received QIP intervention initiated as follows: (1) Protocols and standard operating procedures were created for TTM; (2) shared decision-making was documented; (3) job training instruction was created; and 4) lean medical management was implemented. RESULTS: Among 248 included patients, the postintervention group (n = 104) had shorter duration of ROSC to TTM than the preintervention group (n = 144) (356 vs 540 minutes, p = 0.042); better survival rate (39.4% vs 27.1%, p = 0.04), and neurologic performance (25.0% vs 17.4%, p < 0.001). After propensity score matching (PSM), patients who received TTM (n = 48 ) had better neurologic performance than those without TTM (n = 48) (25.1% vs 18.8%, p < 0.001). OHCA (odds ratio [OR] = 2.705, 95% CI: 1.657-4.416), age >60 (OR = 2.154, 95% CI: 1.428-3.244), female (OR = 1.404, 95% CI: 1.005-1.962), and diabetes mellitus (OR = 1.429, 95% CI: 1.019-2.005) were negative predictors of survival; while TTM (OR = 0.431, 95% CI: 0.266-0.699) and bystander cardiopulmonary resuscitation (CPR) (OR=0.589, 95% CI: 0.35-0.99) were positive predictors. Age >60 (OR= 2.292, 95% CI: 1.58-3.323) and OHCA (OR= 2.928, 95% CI: 1.858-4.616) were negative predictors of favorable neurologic outcomes; while bystander CPR (OR=0.572, 95% CI: 0.355-0.922) and TTM (OR=0.457, 95% CI: 0.296-0.705) were positive predictors. CONCLUSION: A new QIP with defined protocols, documented shared decision-making, and medical management guidelines improves TTM execution, duration from ROSC to TTM , survival, and neurologic outcomes of cardiac arrest patients.

**9.** Eur Heart J Acute Cardiovasc Care. 2023 Jul 22:zuad087. doi: 10.1093/ehjacc/zuad087. Online ahead of print.

**Sedation and Shivering Management After Cardiac Arrest.**

Geller BJ(1), Maciel CB(2), May TL(3), Jentzer JC(4).

**ABSTRACT**

Management of sedation and shivering during targeted temperature management (TTM) after cardiac arrest is limited by a dearth of high-quality evidence to guide clinicians. Data from general intensive care unit (ICU) populations can likely be extrapolated to post cardiac arrest patients, but clinicians should be mindful of key differences that exist between these populations. Most importantly, the goals of sedation after cardiac arrest are distinct from other ICU patients, and may also involve suppression of shivering during TTM. Drug metabolism and clearance is altered considerably during TTM when a low goal temperature is used, which can delay accurate neuroprognostication. When neuromuscular blockade is used to prevent shivering, sedation should be deep enough to prevent awareness and providers should be aware that this can mask clinical manifestations of seizures. However, excessively deep or prolonged sedation is associated with complications including delirium, infections, increased duration of ventilatory support, prolonged ICU length of stay, and delays in neuroprognostication. In this manuscript, we review sedation and shivering management best practices in the post cardiac arrest patient population.

**PEDIATRICS AND CHILDREN**

**1.** World J Pediatr. 2023 Jun 30. doi: 10.1007/s12519-023-00738-2. Online ahead of print.
**Delivery room resuscitation intensity and associated neonatal outcomes of 24(+0)-31(+6) weeks' preterm infants in China: a retrospective cross-sectional study.**
Wang SL(1), Chen C(2), Gu XY(3), Yin ZQ(4), Su L(4), Jiang SY(3)(5), Cao Y(3)(5), Du LZ(6), Sun JH(7), Liu JQ(8), Yang CZ(9); Chinese Neonatal Network Investigators.
**ABSTRACT**
BACKGROUND: The aim of this study was to review current delivery room (DR) resuscitation intensity in Chinese tertiary neonatal intensive care units and to investigate the association between DR resuscitation intensity and short-term outcomes in preterm infants born at 24+0-31+6 weeks' gestation age (GA). METHODS: This was a retrospective cross-sectional study. The source population was infants born at 24+0-31+6 weeks' GA who were enrolled in the Chinese Neonatal Network 2019 cohort. Eligible infants were categorized into five groups: (1) regular care; (2) oxygen supplementation and/or continuous positive airway pressure (O2/CPAP); (3) mask ventilation; (4) endotracheal intubation; and (5) cardiopulmonary resuscitation (CPR). The association between DR resuscitation and short-term outcomes was evaluated by inverse propensity score-weighted logistic regression. RESULTS: Of 7939 infants included in this cohort, 2419 (30.5%) received regular care, 1994 (25.1%) received O2/CPAP, 1436 (18.1%) received mask ventilation, 1769 (22.3%) received endotracheal intubation, and 321 (4.0%) received CPR in the DR. Advanced maternal age and maternal hypertension correlated with a higher need for resuscitation, and antenatal steroid use tended to be associated with a lower need for resuscitation ($P < 0.001$). Severe brain impairment increased significantly with increasing amounts of resuscitation in DR after adjusting for perinatal factors. Resuscitation strategies vary widely between centers, with over 50% of preterm infants in eight centers requiring higher intensity resuscitation. CONCLUSIONS: Increased intensity of DR interventions was associated with increased mortality and morbidities in very preterm infants in China. There is wide variation in resuscitative approaches across delivery centers, and ongoing quality improvement to standardize resuscitation practices is needed.

**2.** Resuscitation. 2023 Jul;188:109849. doi: 10.1016/j.resuscitation.2023.109849. Epub 2023 May 23.
**Physiologic monitoring during Pediatric Cardiac Arrest: Are we flying blind?**
Haskell S(1), de Caen A(2).
**NO ABSTRACT AVAILABLE**

**3.** Resuscitation. 2023 Jul;188:109756. doi: 10.1016/j.resuscitation.2023.109756.
**What is the best chest compression technique for a cardiac arrest infant?**
Oh JH(1).
**NO ABSTRACT AVAILABLE**

**4.** Pediatrics. 2023 Aug 1;152(2):e2022060790. doi: 10.1542/peds.2022-060790.
**Factors Associated With Improved Pediatric Resuscitative Care in General Emergency Departments.**
Auerbach MA(1), Whitfill T(1), Montgomery E(2), Leung J(3), Kessler D(4), Gross IT(1), Walsh BM(5), Fiedor Hamilton M(6), Gawel M(1), Kant S(7), Janofsky S(6), Brown LL(8), Walls TA(9), Alletag M(10), Sessa A(11), Arteaga GM(12), Keilman A(13), Van Ittersum W(14), Rutman MS(11), Zaveri P(15), Good G(9), Schoen JC(16), Lavoie M(9), Mannenbach M(12), Bigham L(17), Dudas RA(17), Rutledge C(18), Okada PJ(19), Moegling M(20), Anderson I(20), Tay KY(9), Scherzer DJ(21), Vora S(22), Gaither S(18), Fenster D(23), Jones D(16), Aebersold M(24), Chatfield J(25), Knight L(26), Berg M(26), Makharashvili A(1), Katznelson J(17), Mathias E(27), Lutfi R(2), Abu-Sultaneh S(2), Burns B(13),

Padlipsky P(28), Lee J(29), Butler L(30), Alander S(31), Thomas A(13), Bhatnagar A(1), Jafri FN(32), Crellin J(31), Abulebda K(2).

**ABSTRACT**

OBJECTIVES: To describe the quality of pediatric resuscitative care in general emergency departments (GEDs) and to determine hospital-level factors associated with higher quality. METHODS: Prospective observational study of resuscitative care provided to 3 in situ simulated patients (infant seizure, infant sepsis, and child cardiac arrest) by interprofessional GED teams. A composite quality score (CQS) was measured and the association of this score with modifiable and nonmodifiable hospital-level factors was explored. RESULTS: A median CQS of 62.8 of 100 (interquartile range 50.5-71.1) was noted for 287 resuscitation teams from 175 emergency departments. In the unadjusted analyses, a higher score was associated with the modifiable factor of an affiliation with a pediatric academic medical center (PAMC) and the nonmodifiable factors of higher pediatric volume and location in the Northeast and Midwest. In the adjusted analyses, a higher CQS was associated with modifiable factors of an affiliation with a PAMC and the designation of both a nurse and physician pediatric emergency care coordinator, and nonmodifiable factors of higher pediatric volume and location in the Northeast and Midwest. A weak correlation was noted between quality and pediatric readiness scores. CONCLUSIONS: A low quality of pediatric resuscitative care, measured using simulation, was noted across a cohort of GEDs. Hospital factors associated with higher quality included: an affiliation with a PAMC, designation of a pediatric emergency care coordinator, higher pediatric volume, and geographic location. A weak correlation was noted between quality and pediatric readiness scores.

**5.** Resuscitation. 2023 Jul 3:109897. doi: 10.1016/j.resuscitation.2023.109897. Online ahead of print.

**Outcomes and characteristics of cardiac arrest in children with pulmonary hypertension: A secondary analysis of the ICU-RESUS clinical trial.**

Morgan RW(1), Reeder RW(2), Ahmed T(3), Bell MJ(4), Berger JT(4), Bishop R(5), Bochkoris M(6), Burns C(7), Carcillo JA(6), Carpenter TC(5), Dean JM(2), Diddle JW(4), Federman M(8), Fernandez R(9), Fink EL(6), Franzon D(10), Frazier AH(11), Friess SH(12), Graham K(13), Hall M(9), Hehir DA(13), Himebauch AS(13), Horvat CM(6), Huard LL(8), Maa T(9), Manga A(12), McQuillen PS(10), Meert KL(3), Mourani PM(14), Nadkarni VM(13), Naim MY(13), Notterman D(15), Page K(2), Pollack MM(4), Sapru A(8), Schneiter C(5), Sharron MP(4), Srivastava N(8), Tabbutt S(10), Tilford B(3), Viteri S(16), Wessel D(4), Wolfe HA(13), Yates AR(9), Zuppa AF(13), Berg RA(13), Sutton RM(13).

**ABSTRACT**

BACKGROUND: Previous studies have identified pulmonary hypertension (PH) as a relatively common diagnosis in children with in-hospital cardiac arrest (IHCA), and preclinical laboratory studies have found poor outcomes and low systemic blood pressures during CPR for PH-associated cardiac arrest. The objective of this study was to determine the prevalence of PH among children with IHCA and the association between PH diagnosis and intra-arrest physiology and survival outcomes. METHODS: This was a prospectively designed secondary analysis of patients enrolled in the ICU-RESUS clinical trial (NCT02837497). The primary exposure was a pre-arrest diagnosis of PH. The primary survival outcome was survival to hospital discharge with favorable neurologic outcome (Pediatric Cerebral Performance Category score 1-3 or unchanged from baseline). The primary physiologic outcome was event-level average diastolic blood pressure (DBP) during CPR. RESULTS: Of 1276 patients with IHCAs during the study period, 1129 index IHCAs were enrolled; 184 (16.3%) had PH and 101/184 (54.9%) were receiving inhaled nitric oxide at the time of IHCA. Survival with favorable neurologic outcome was similar between patients with and without PH on univariate (48.9% vs. 54.4%; p = 0.17) and multivariate analyses (aOR 0.82 [95%CI: 0.56, 1.20]; p = 0.32). There were no significant differences in CPR event outcome or survival to hospital discharge. Average DBP,

systolic BP, and end-tidal carbon dioxide during CPR were similar between groups. CONCLUSIONS: In this prospective study of pediatric IHCA, pre-existing PH was present in 16% of children. Pre-arrest PH diagnosis was not associated with statistically significant differences in survival outcomes or intra-arrest physiologic measures.

**6.** JAMA Netw Open. 2023 Jun 1;6(6):e2320713. doi: 10.1001/jamanetworkopen.2023.20713.
**Assessment of Brain Magnetic Resonance and Spectroscopy Imaging Findings and Outcomes After Pediatric Cardiac Arrest.**
Fink EL(1)(2)(3), Kochanek PM(1)(2)(3), Beers SR(4), Clark RRSB(1)(2)(3), Berger RP(2)(3), Bayir H(1)(2)(3), Topjian AA(5), Newth C(6), Press C(5), Maddux AB(7), Willyerd F(8), Hunt EA(9), Siems A(9), Chung MG(10), Smith L(11), Doughty L(12), Diddle JW(13), Patregnani J(13), Piantino J(14), Walson KH(15), Balakrishnan B(16), Meyer MT(16), Friess S(17), Pineda J(18), Maloney D(1), Rubin P(1), Haller TL(19), Treble-Barna A(20), Wang C(19), Lee V(21), Wisnowski JL(22), Subramanian S(21), Narayanan S(21), Blüml S(22), Fabio A(19), Panigrahy A(21); POCCA Investigators.
**ABSTRACT**
IMPORTANCE: Morbidity and mortality after pediatric cardiac arrest are chiefly due to hypoxic-ischemic brain injury. Brain features seen on magnetic resonance imaging (MRI) and magnetic resonance spectroscopy (MRS) after arrest may identify injury and aid in outcome assessments. OBJECTIVE: To analyze the association of brain lesions seen on T2-weighted MRI and diffusion-weighted imaging and N-acetylaspartate (NAA) and lactate concentrations seen on MRS with 1-year outcomes after pediatric cardiac arrest. DESIGN, SETTING, AND PARTICIPANTS: This multicenter cohort study took place in pediatric intensive care units at 14 US hospitals between May 16, 2017, and August 19, 2020. Children aged 48 hours to 17 years who were resuscitated from in-hospital or out-of-hospital cardiac arrest and who had a clinical brain MRI or MRS performed within 14 days postarrest were included in the study. Data were analyzed from January 2022 to February 2023. EXPOSURE: Brain MRI or MRS. MAIN OUTCOMES AND MEASURES: The primary outcome was an unfavorable outcome (either death or survival with a Vineland Adaptive Behavior Scales, Third Edition, score of <70) at 1 year after cardiac arrest. MRI brain lesions were scored according to region and severity (0 = none, 1 = mild, 2 = moderate, 3 = severe) by 2 blinded pediatric neuroradiologists. MRI Injury Score was a sum of T2-weighted and diffusion-weighted imaging lesions in gray and white matter (maximum score, 34). MRS lactate and NAA concentrations in the basal ganglia, thalamus, and occipital-parietal white and gray matter were quantified. Logistic regression was performed to determine the association of MRI and MRS features with patient outcomes. RESULTS: A total of 98 children, including 66 children who underwent brain MRI (median [IQR] age, 1.0 [0.0-3.0] years; 28 girls [42.4%]; 46 White children [69.7%]) and 32 children who underwent brain MRS (median [IQR] age, 1.0 [0.0-9.5] years; 13 girls [40.6%]; 21 White children [65.6%]) were included in the study. In the MRI group, 23 children (34.8%) had an unfavorable outcome, and in the MRS group, 12 children (37.5%) had an unfavorable outcome. MRI Injury Scores were higher among children with an unfavorable outcome (median [IQR] score, 22 [7-32]) than children with a favorable outcome (median [IQR] score, 1 [0-8]). Increased lactate and decreased NAA in all 4 regions of interest were associated with an unfavorable outcome. In a multivariable logistic regression adjusted for clinical characteristics, increased MRI Injury Score (odds ratio, 1.12; 95% CI, 1.04-1.20) was associated with an unfavorable outcome. CONCLUSIONS AND RELEVANCE: In this cohort study of children with cardiac arrest, brain features seen on MRI and MRS performed within 2 weeks after arrest were associated with 1-year outcomes, suggesting the utility of these imaging modalities to identify injury and assess outcomes.

**7.** Prehosp Emerg Care. 2023;27(5):687-694. doi: 10.1080/10903127.2022.2074180. Epub 2022 May 23.

**Identification of Factors Associated with Return of Spontaneous Circulation after Pediatric Out-of-Hospital Cardiac Arrest Using Natural Language Processing.**

Harris M(1), Crowe RP(2), Anders J(3), D'Acunto S(4), Adelgais KM(5), Fishe JN(4)(6).

**ABSTRACT**

INTRODUCTION: Prior studies examining prehospital characteristics related to return of spontaneous circulation (ROSC) in pediatric out-of-hospital cardiac arrest (OHCA) are limited to structured data. Natural language processing (NLP) could identify new factors from unstructured data using free-text narratives. The purpose of this study was to use NLP to examine EMS clinician free-text narratives for characteristics associated with prehospital ROSC in pediatric OHCA. METHODS: This was a retrospective analysis of patients ages 0-17 with OHCA in 2019 from the ESO Data Collaborative. We performed an exploratory analysis of EMS narratives using NLP with an a priori token library. We then constructed biostatistical and machine learning models and compared their performance in predicting ROSC. RESULTS: There were 1,726 included EMS encounters for pediatric OHCA; 60% were male patients, and the median age was 1 year (IQR 0-9). Most cardiac arrest events (61.3%) were unwitnessed, 87.3% were identified as having medical causes, and 5.9% had initial shockable rhythms. Prehospital ROSC was achieved in 23.1%. Words most positively correlated with ROSC were "ROSC" ($r = 0.42$), "pulse" ($r = 0.29$), "drowning" ($r = 0.13$), and "PEA" ($r = 0.12$). Words negatively correlated with ROSC included "asystole" ($r = -0.25$), "lividity" ($r = -0.14$), and "cold" ($r = -0.14$). The terms "asystole," "pulse," "no breathing," "PEA," and "dry" had the greatest difference in frequency of appearance between encounters with and without ROSC ($p < 0.05$). The best-performing model for predicting prehospital ROSC was logistic regression with random oversampling using free-text data only (area under the receiver operating characteristic curve 0.92). CONCLUSIONS: EMS clinician free-text narratives reveal additional characteristics associated with prehospital ROSC in pediatric OHCA. Incorporating those terms into machine learning models of prehospital ROSC improves predictive ability. Therefore, NLP holds promise as a tool for use in predictive models with the goal to increase evidence-based management of pediatric OHCA.

**8.** J Emerg Med. 2023 Jun;64(6):696-708. doi: 10.1016/j.jemermed.2023.03.058. Epub 2023 Mar 22.

**Pediatric Chest Compression Improvement Via Augmented Reality Cardiopulmonary Resuscitation Feedback in Community General Emergency Departments: A Mixed-Methods Simulation-Based Pilot Study.**

Kleinman K(1), Hairston T(2), Smith B(3), Billings E(3), Tackett S(4), Chopra E(5), Risko N(5), Swedien D(5), Schreurs BA(6), Dean JL(6), Scott B(6), Canares T(3), Jeffers JM(3).

**ABSTRACT**

BACKGROUND: Yearly, more than 20,000 children experience a cardiac arrest. High-quality pediatric cardiopulmonary resuscitation (CPR) is generally challenging for community hospital teams, where pediatric cardiac arrest is infrequent. Current feedback systems are insufficient. Therefore, we developed an augmented reality (AR) CPR feedback system for use in many settings. OBJECTIVE: We aimed to evaluate whether AR-CPR improves chest compression (CC) performance in non-pediatric-specialized community emergency departments (EDs). METHODS: We performed an unblinded, randomized, crossover simulation-based study. A convenience sample of community ED nonpediatric nurses and technicians were included. Each participant performed three 2-min cycles of CC during a simulated pediatric cardiac arrest. Participants were randomized to use AR-CPR in one of three CC cycles. Afterward, participants participated in a qualitative interview to inquire about their experience with AR-CPR. RESULTS: Of 36 participants, 18 were randomized to AR-CPR in cycle 2 (group A) and 18 were randomized to AR-CPR in cycle 3 (group B). When using AR-CPR, 87-90%

(SD 12-13%) of all CCs were in goal range, analyzed as 1-min intervals, compared with 18-21% (SD 30-33%) without feedback ($p < 0.001$). Analysis of qualitative themes revealed that AR-CPR may be usable without a device orientation, be effective at cognitive offloading, and reduce anxiety around and enhance confidence in the CC delivered. CONCLUSIONS: The novel CPR feedback system, AR-CPR, significantly changed the CC performance in community hospital non-pediatric-specialized general EDs from 18-21% to 87-90% of CC epochs at goal. This study offers preliminary evidence suggesting AR-CPR improves CC quality in community hospital settings.

**9.** Resusc Plus. 2023 Jun 8;14:100409. doi: 10.1016/j.resplu.2023.100409. eCollection 2023 Jun.
**Identifying high cognitive load activities during simulated pediatric cardiac arrest using functional near-infrared spectroscopy.**
Ivankovic J(1), Bahr N(1), Meckler GD(2), Hansen M(3), Eriksson C(4), Guise JM(5).
**ABSTRACT**
AIM: To identify specific activities associated with high cognitive load during simulated pediatric out-of-hospital cardiac arrest (POHCA) resuscitation using physiological monitoring with functional near-infrared spectroscopy (fNIRS). METHODS: We recruited teams of emergency medical services (EMS) responders from fire departments located throughout the Portland, OR metropolitan area to participate in POHCA simulations. Teams consisted of both paramedics and emergency medical technicians (EMTs), with one paramedic serving as the person in charge (PIC). The PIC was outfitted with the OctaMon to collect fNIRS signals from the prefrontal cortex. Signals reported changes in oxygenated and deoxygenated hemoglobin concentrations, which were used to determine moments of increased cognitive activity. Increased cognitive activity was determined by significant increases in oxygenated hemoglobin and decreases in deoxygenated hemoglobin. Significant changes in fNIRS signals were associated with specific concurrent clinical tasks recorded by two independent researchers using video review. RESULTS: We recorded cognitive activity of EMS providers in 18 POHCA simulations. We found that a proportion of PIC's experienced relatively high cognitive load during medication administration, defibrillation, and rhythm checks compared to other events. CONCLUSION: EMS providers commonly experienced increased cognitive activity during key resuscitation tasks that were related to safely coordinating team members around calculating and administering medications, defibrillation, and rhythm and pulse checks. Understanding more about activities that require high cognitive demand can inform future interventions that reduce cognitive load.

**10.** Pediatr Emerg Care. 2023 Jul 19. doi: 10.1097/PEC.0000000000003017. Online ahead of print.
**Optimizing Education During Pediatric Resident Mock Code Sessions.**
Zimmerman E(1), Wai SS(2), Hollenbach KA(1), Cameron MA(1).
**ABSTRACT**
INTRODUCTION: Most pediatric residents have limited opportunities to manage cardiac arrest. We used simulation to fill that educational void. Given work hours and other obligations, resident education sessions must be high-yield. We examined the effectiveness of adding varying amounts of formal education to a mock code session on resident knowledge and confidence in managing pediatric cardiac arrest compared with participation alone. METHODS: Convenient groups of 3 to 8 pediatric residents completed a simulation session with the identical scenario: a 3-month-old infant with pulseless ventricular tachycardia and then pulseless electrical activity. All residents completed pretests and posttests, which consisted of open-ended knowledge questions from the American Heart Association Pediatric Advanced Life Support guidelines and confidence Likert scale assessments. Resident groups were assigned to 1 of 3 educational models: experiential-only: participation in the mock, traditional: mock code participation with standardized education after the

mock code, or reinforced: standardized education before and after mock code participation. RESULTS: Ninety-five residents participated. Collectively, residents demonstrated a median 2-point (interquartile range, 1-4) increase in knowledge (test maximum score, 10) after they attended a mock code simulation session ($P < 0.0001$); however, there were no statistically significant differences noted between educational modalities. All residents also demonstrated a 4-point median increase in confidence (test maximum score, 25) after completing their simulation session (interquartile range, 3-6) ($P < 0.001$), but no differences were seen by type or amount of accompanying education. CONCLUSIONS: Residents had gains in confidence and knowledge of pediatric cardiac arrest management after participation in the mock code. Formal educational sessions and reinforced formal education sessions accompanying the mock code did not significantly increase knowledge or confidence.

**11.** Pediatr Crit Care Med. 2023 Jul 17. doi: 10.1097/PCC.0000000000003321. Online ahead of print.
**Critical Care Unit Characteristics and Extracorporeal Cardiopulmonary Resuscitation Survival in the Pediatric Cardiac Population: Retrospective Analysis of the Virtual Pediatric System Database.**
Lasa JJ(1)(2), Guffey D(3), Bhalala U(4), Thiagarajan RR(5).

**ABSTRACT**

OBJECTIVES: Existing literature provides limited data about ICU characteristics and pediatric extracorporeal cardiopulmonary resuscitation (E-CPR) outcomes. We aimed to evaluate the associations between patient and ICU characteristics, and outcomes after E-CPR in the pediatric cardiac population. DESIGN: Retrospective analysis of the Virtual Pediatric System database (VPS, LLC, Los Angeles, CA). SETTING: PICUs categorized as either cardiac-only versus mixed ICU cohort type. PATIENTS: Consecutive cardiac patients less than 18 years old experiencing cardiac arrest in the ICU and resuscitated using E-CPR. INTERVENTIONS: None. MEASUREMENTS AND MAIN RESULTS: Event and time-stamp filtering identified E-CPR events. Patient, hospital, and event-related variables were aggregated for independent and multivariable mixed effects logistic regression to assess the association between ICU cohort type and survival. Among ICU admissions in the VPS database, 2010-2018, the prevalence of E-CPR was 0.07%. A total of 671 E-CPR events (650 patients) comprised the final cohort; congenital heart disease (84%) was the most common diagnosis versus acquired heart diseases. The majority of E-CPR events occurred in mixed ICUs (67%, n = 449) and in ICUs with greater than 20 licensed bed capacity (65%, n = 436). Survival to hospital discharge was 51% for the overall cohort. Independent logistic regression failed to reveal any association between survival to hospital discharge and ICU type (ICU type: cardiac ICU, odds ratio [OR], 1.01; 95% CI, 0.71-1.44; p = 0.95). However, multivariable logistic regression revealed an association between cardiac surgical patients and greater odds for survival (OR, 2.03; 95% CI, 1.40-2.95; $p < 0.001$). Also, there was an association between ICUs with capacity greater than 20 (vs not) and lower survival odds (OR, 0.65; 95% CI, 0.43-0.96). CONCLUSIONS: The overall prevalence of E-CPR among critically ill children with cardiac disease observed in the VPS database is low. We failed to identify an association between ICU cohort type and survival. Further investigation into organizational factors is warranted.

**12.** J Pers Med. 2023 Jun 28;13(7):1061. doi: 10.3390/jpm13071061.
**Arterial Blood Gas Analysis for Survival Prediction in Pediatric Patients with Out-of-Hospital Cardiac Arrest.**
Lee SH(1), Shin H(1), Cho Y(1), Oh J(1), Choi HJ(1), The Korean Cardiac Arrest Research Consortium KoCARC Investigators(1).

**ABSTRACT**

Arterial blood gas analysis (ABGA) is one of the few tests performed during cardiopulmonary resuscitation (CPR). There have been some studies on the prediction of survival outcomes in adult

out-of-hospital cardiac arrest (OHCA) patients during CPR using ABGA results. However, in pediatric OHCA patients, the prognosis of survival outcome based on ABGA results during CPR remains unclear. We retrospectively analyzed prospectively collected data from the Korean Cardiac Arrest Resuscitation Consortium (KoCARC) registry, a multicenter OHCA registry of Republic of Korea. We analyzed 108 pediatric (age < 19 years) OHCA patients between October 2015 and June 2022. Using multivariable logistic regression, an adjusted odds ratio (aOR) was obtained to validate the ABGA results of survival to hospital admission and survival to discharge. The variables associated with survival to hospital admission were non-comorbidities (aOR 3.03, 95% confidence interval (CI) 1.22-7.53, p = 0.017) and PaO2 > 45.750 mmHg (aOR 2.69, 95% CI 1.13-6.42, p = 0.026). There was no variable that was statistically significant association with survival to discharge. PaO2 > 47.750 mmHg and non-comorbidities may serve as an independent prognostic factor for survival to hospital admission in pediatric OHCA patients. However, the number of cases analyzed in our study was relatively small, and there have been few studies investigating the association between ABGA results during CPR and the survival outcome of pediatric OHCA patients. Therefore, further large-scale studies are needed.

**13.** J Am Heart Assoc. 2023 Jul 25:e029972. doi: 10.1161/JAHA.123.029972. Online ahead of print.
**Association of Growth Differentiation Factor-15 With Event Cause and Cardiovascular Failure After Pediatric Cardiac Arrest in a Multi-Institutional Trial.**
Herrmann JR(1), Jackson TC(2), Fabio A(3), Clark RSB(1)(4), Berger RP(4), Janesko-Feldman KL(1), Kochanek PM(1)(4), Fink EL(1)(4); POCCA Investigators *.
**NO ABSTRACT AVAILABLE**

**EXTRACORPOREAL LIFE SUPPORT**

**1.** World J Clin Cases. 2023 Jun 16;11(17):4098-4104. doi: 10.12998/wjcc.v11.i17.4098.
**Cardiac arrest secondary to pulmonary embolism treated with extracorporeal cardiopulmonary resuscitation: Six case reports.**
Qiu MS(1), Deng YJ(1), Yang X(1), Shao HQ(2).
**ABSTRACT**
BACKGROUND: Massive pulmonary embolism (PE) results in extremely high mortality rates. Veno-arterial extracorporeal membrane oxygenation (VA-ECMO) can provide circulatory and oxygenation support and rescue patients with massive PE. However, there are relatively few studies of extracorporeal cardiopulmonary resuscitation (ECPR) in patients with cardiac arrest (CA) secondary to PE. The aim of the present study is to investigate the clinical use of ECPR in conjunction with heparin anticoagulation in patients with CA secondary to PE. CASE SUMMARY: We report the cases of six patients with CA secondary to PE treated with ECPR in the intensive care unit of our hospital between June 2020 and June 2022. All six patients experienced witnessed CA whilst in hospital. They had acute onset of severe respiratory distress, hypoxia, and shock rapidly followed by CA and were immediately given cardiopulmonary resuscitation and adjunctive VA-ECMO therapy. During hospitalization, pulmonary artery computed tomography angiography was performed to confirm the diagnosis of PE. Through anticoagulation management, mechanical ventilation, fluid management, and antibiotic treatment, five patients were successfully weaned from ECMO (83.33%), four patients survived for 30 d after discharge (66.67%), and two patients had good neurological outcomes (33.33%). CONCLUSION: For patients with CA secondary to massive PE, ECPR in conjunction with heparin anticoagulation may improve outcomes.

**2.** Intern Emerg Med. 2023 Jun 30. doi: 10.1007/s11739-023-03357-x. Online ahead of print.

**Extracorporeal cardiopulmonary resuscitation for refractory out-of-hospital cardiac arrest: a systematic review and meta-analysis of randomized clinical trials.**

Gomes DA(#)(1), Presume J(#)(2)(3), Ferreira J(4), Oliveira AF(4)(5), Miranda T(6), Brízido C(4)(7), Strong C(4), Tralhão A(4)(7).

**ABSTRACT**

INTRODUCTION: Extracorporeal cardiopulmonary resuscitation (ECPR) is currently recommended as a rescue therapy for selected patients in refractory out-of-hospital cardiac arrest (OHCA). However, there is conflicting evidence regarding its effect on survival and neurological outcomes. We conducted a systematic review and meta-analysis of randomized clinical trials (RCTs) to evaluate whether ECPR is superior to standard CPR in refractory OHCA. METHODS: We performed a systematic search of electronic databases (PubMed, CENTRAL, and Scopus) until March 2023. Studies were eligible if they a) were RCTs, and b) compared ECPR vs. standard CPR for OHCA. Outcomes were defined as survival with a favorable neurological status (cerebral performance category 1 or 2) at both the shortest follow-up and at 6 months, and in-hospital mortality. Meta-analyses using a random-effects model were undertaken. RESULTS: Three RCTs, with a total of four hundred and eighteen patients, were included. Compared with standard CPR, ECPR was associated with a non-statistically significant higher rate of survival with a favorable neurological outcome at the shortest follow-up (26.4% vs. 17.2%; RR 1.47 [95% CI 0.91-2.40], P = 0.12) and at 6 months (28.3% vs. 18.6%; RR 1.48 [95% CI 0.88-2.49], P = 0.14). The mean absolute rate of in-hospital mortality was not significantly lower in the ECPR group (RR 0.89 [95% CI 0.74-1.07], P = 0.23). CONCLUSION: ECPR was not associated with a significant improvement in survival with favorable neurologic outcomes in refractory OHCA patients. Nevertheless, these results constitute the rationale for a well-conducted, large-scale RCT, aiming to clarify the effectiveness of ECPR compared to standard CPR.

**3.** Crit Care. 2023 Jun 27;27(1):252. doi: 10.1186/s13054-023-04534-2.

**Prevalence, reasons, and timing of decisions to withhold/withdraw life-sustaining therapy for out-of-hospital cardiac arrest patients with extracorporeal cardiopulmonary resuscitation.**

Naito H(#)(1), Sakuraya M(#)(2), Hongo T(3), Takada H(4), Yumoto T(3), Yorifuji T(5), Hifumi T(6), Inoue A(7), Sakamoto T(8), Kuroda Y(9), Nakao A(3); SAVE-J II Study Group.

**ABSTRACT**

BACKGROUND: Extracorporeal cardiopulmonary resuscitation (ECPR) is rapidly becoming a common treatment strategy for patients with refractory cardiac arrest. Despite its benefits, ECPR raises a variety of ethical concerns when the treatment is discontinued. There is little information about the decision to withhold/withdraw life-sustaining therapy (WLST) for out-of-hospital cardiac arrest (OHCA) patients after ECPR. METHODS: We conducted a secondary analysis of data from the SAVE-J II study, a retrospective, multicenter study of ECPR in Japan. Adult patients who underwent ECPR for OHCA with medical causes were included. The prevalence, reasons, and timing of WLST decisions were recorded. Outcomes of patients with or without WLST decisions were compared. Further, factors associated with WLST decisions were examined. RESULTS: We included 1660 patients in the analysis; 510 (30.7%) had WLST decisions. The number of WLST decisions was the highest on the first day and WSLT decisions were made a median of two days after ICU admission. Reasons for WLST were perceived unfavorable neurological prognosis (300/510 [58.8%]), perceived unfavorable cardiac/pulmonary prognosis (105/510 [20.5%]), inability to maintain extracorporeal cardiopulmonary support (71/510 [13.9%]), complications (10/510 [1.9%]), exacerbation of comorbidity before cardiac arrest (7/510 [1.3%]), and others. Patients with WLST had lower 30-day survival (WLST vs. no-WLST: 36/506 [7.1%] vs. 386/1140 [33.8%], p < 0.001). Primary cerebral disorders as cause of cardiac arrest and higher severity of illness at intensive care unit admission were associated with WLST decisions. CONCLUSION: For approximately one-third of ECPR/OHCA patients, WLST was decided during admission, mainly because of perceived unfavorable neurological prognoses. Decisions and neurological assessments for ECPR/OHCA patients need further analysis.

**4.** Prehosp Emerg Care. 2023 Jul 12:1-7. doi: 10.1080/10903127.2023.2229912. Online ahead of print.

**ECPR Survivor Estimates: A Simulation-Based Approach to Comparing ECPR Delivery Strategies.**

Kruit N(1)(2)(3), Song C(4), Tian D(2)(5), Moylan E(4), Dennis M(1)(6).

**ABSTRACT**

Objective: The number of out-of-hospital cardiac arrest (OHCA) patients who may benefit from prehospital extracorporeal cardiopulmonary resuscitation (ECPR) is yet to be elucidated. Patient eligibility is determined both by case characteristics and physical proximity to an ECPR service. We applied accessibility principles to historical cardiac arrest data, to identify the number of patients who would have been eligible for prehospital ECPR in Sydney, Australia, and the potential survival benefit had prehospital ECPR been available. Methods: The New South Wales cardiac arrest registry between January 2017 to June 2021 included 39,387 cardiac arrests. We retrospectively defined two groups: 1) possible ECPR eligible arrests that would have triggered activation of a team, and 2) ECPR eligible arrests, those arrests that met ECPR inclusion criteria and remained refractory. Transport accessibility modeling was used to ascertain the number of arrests that would have been served by a hypothetical prehospital service and the potential survival benefit. Results: There were 699 arrests screened as possibly ECPR eligible in the Sydney metropolitan area, 488 of whom were subsequently confirmed as ECPR eligible refractory OHCA. Of these, 38% (n = 185) received intra-arrest transfer to hospital, with 37% (n = 180) arriving within 60 min. Using spatial and transport modeling, a prehospital team located at an optimal location could establish 437 (90%) patients onto ECMO within 60 min, with an estimated survival of 48% (IQR 38-57). Based on existing survival curves, compared to conventional CPR, an optimally located prehospital ECPR service has the potential to save one additional life for every 3.0 patients. Conclusions: A significant number of historical OHCA patients could have benefited from prehospital ECPR, with a potential survival benefit above conventional CPR.

**5.** Clin Exp Emerg Med. 2023 Jul 13. doi: 10.15441/ceem.23.063. Online ahead of print.

**Extracorporeal cardiopulmonary resuscitation: a review of recent literature on its benefits, key protocol components, and considerations for successful implementation.**

Jeung KW(1)(2), Jung YH(1)(2), Gumucio JA(3), Salcido DD(3), Menegazzi JJ(3).

**ABSTRACT**

The application of venoarterial extracorporeal membrane oxygenation (ECMO) in patients unresponsive to conventional cardiopulmonary resuscitation (CPR) has significantly increased in recent years. To date, 3 published randomized trials have investigated extracorporeal CPR (ECPR) in adults with refractory out-of-hospital cardiac arrest. Although these trials reported inconsistent results, they suggest that ECPR may have a significant survival benefit over conventional CPR in selected patients only when performed with strict protocol adherence in an experienced EMS-Hospital system. Several studies suggest that identifying suitable ECPR candidates and reducing the time from cardiac arrest to ECMO initiation are key to successful outcomes. Prehospital ECPR or the rendezvous approach may allow more patients to receive ECPR within acceptable timeframes than ECPR initiation on arrival at a capable hospital. ECPR is only one part of the system of care for resuscitation of cardiac arrest victims. Optimizing the chain of survival is critical to improving outcomes of patients receiving ECPR. Further studies are needed to find the optimal strategy for the use of ECPR.

**6.** J Thorac Dis. 2023 Jun 30;15(6):3079-3088. doi: 10.21037/jtd-22-1297. Epub 2023 May 9.

**Upgrading extra corporeal life support to ECMELLA using Impella 5.0 in rescued INTERMACS 1 patients, lactate level matters!**

Aludaat C(1)(2), Dovonou E(1), Besnier E(3)(4), Fauvel C(2)(5), Nardone N(1), Le Guillou V(1), D'Agostino A(1), Nafeh-Bizet C(1), Gay A(1), Bouchart F(1), Bauer F(1)(2)(3).

**ABSTRACT**
BACKGROUND: Venoarterial extra corporeal life support (ECLS) is the treatment of choice of Interagency Registry for Mechanically Assisted Circulatory Support (INTERMACS) class 1 patients, but left ventricle (LV) overload is a complication of ECLS. Unloading the LV by adding Impella 5.0 to ECLS in Impella used in combination with venoarterial extracorporeal membrane oxygenation (ECMELLA) configuration is recommended only in patients with acceptable prognosis. We investigated whether serum lactate level, a simple biological parameter, could be used as a marker to select candidates for bridging from ECLS to ECMELLA. METHODS: Forty-one consecutive INTERMACS 1 patients under ECLS were upgraded to ECMELLA using Impella 5.0 pump implantation to unload the LV and were followed-up for 30 days. Demographic, clinical, imaging, and biological parameters were collected. RESULTS: The time between ECLS and Impella 5.0 pump implantation was 9 [0-30] hours. Among these 41 patients, 25 died 6±6 days after implantation. They were older (53±12 vs. 43±12 years, P=0.01) with acute coronary syndrome as the primary etiology (64% vs. 13%, P=0.0007). In univariate analysis, patients who died exhibited a lower mean arterial pressure (74±17 vs. 89±9 mmHg, P=0.01), a higher level of troponin (24,000±38,000 vs. 3,500±5,000 mg/dL, P=0.048), a higher level of serum lactate (8.3±7.4 vs. 4.2±3.8 mmol/L, P=0.05) and more frequent cardiac arrest at admission (80% vs. 25%, P=0.03). In multivariate Cox regression analysis, a serum lactate level of >7.9 mmol/L (P=0.008) was found to be an independent predictor of mortality. CONCLUSIONS: In INTERMACS 1 patients who require urgent ECLS for restoring hemodynamics and organ perfusion, an upgrade from ECLS to ECMELLA is relevant if the serum lactate level is ≤7.9 mmol/L.

**7.** Eur Heart J Acute Cardiovasc Care. 2023 Jul 22:zuad071. doi: 10.1093/ehjacc/zuad071. Online ahead of print.
**ECPR for refractory OHCA - lessons from 3 randomized controlled trials. The trialists´view.**
Ubben JFH(1)(2), Heuts S(3)(4), Delnoij TSR(1)(5), Suverein MM(1), van de Koolwijk AF(1), van der Horst ICC(1)(4), Maessen JG(3)(4), Bartos J(6), Kavalkova P(7), Rob D(7), Yannopoulos D(6), Bělohlávek J(7), Lorusso R(3)(4), van de Poll MCG(1)(8).
**ABSTRACT**
Extracorporeal cardiopulmonary resuscitation is a promising treatment for refractory out-of-hospital cardiac arrest. Three recent randomized trials (ARREST-trial, Prague OHCA study, and INCEPTION-trial) that addressed the clinical benefit of ECPR in out-of-hospital cardiac arrest, yielded seemingly diverging results. The evidence for extracorporeal cardiopulmonary resuscitation in out-of-hospital cardiac arrest, derived from three recent RCT's, is not contradictory but rather complementary. Excellent results can be achieved with a very high level of dedication, provided that strict selection criteria are applied. However, pragmatic implementation of extracorporeal cardiopulmonary resuscitation does not necessarily lead to improved outcome of refractory out-of-hospital cardiac arrest. Centers that are performing extracorporeal cardiopulmonary resuscitation for out-of-hospital cardiac arrest or aspire to do so, should critically evaluate whether they are able to meet the prerequisites that are needed to conduct an effective extracorporeal cardiopulmonary resuscitation program.

**8.** Pediatr Crit Care Med. 2023 Jul 21. doi: 10.1097/PCC.0000000000003322. Online ahead of print.
**Outcome of Extracorporeal Cardiopulmonary Resuscitation in Pediatric Patients Without Congenital Cardiac Disease: Extracorporeal Life Support Organization Registry Study.**
Beni CE(1), Rice-Townsend SE(2), Esangbedo ID(3), Jancelewicz T(4), Vogel AM(5), Newton C(6), Boomer L(7), Rothstein DH(2).
**ABSTRACT**
OBJECTIVES: To describe the use of extracorporeal cardiopulmonary resuscitation (ECPR) in pediatric patients without congenital heart disease (CHD) and identify associations with in-hospital mortality, with a specific focus on initial arrest rhythm. DESIGN: Retrospective cohort study using data from pediatric patients enrolled in Extracorporeal Life Support Organization (ELSO) registry between

January 1, 2017, and December 31, 2019. SETTING: International, multicenter. PATIENTS: We included ECPR patients under 18 years old, and excluded those with CHD. Subgroup analysis of patients with initial arrest rhythm. INTERVENTIONS: None. MEASUREMENTS AND MAIN RESULTS: We identified 567 patients: neonates (12%), infants (27%), children between 1 and 5 years old (25%), and children over 5 years old (36%). The patient cohort included 51% males, 43% of White race, and 89% not obese. Most suffered respiratory disease (26%), followed by acquired cardiac disease (25%) and sepsis (12%). In-hospital mortality was 59%. We found that obesity (adjusted odds ratio [aOR], 2.28; 95% CI, 1.21-4.31) and traumatic injury (aOR, 6.94; 95% CI, 1.55-30.88) were associated with greater odds of in-hospital mortality. We also identified lower odds of death associated with White race (aOR, 0.64; 95% CI, 0.45-0.91), ventricular tachycardia (VT) as an initial arrest rhythm (aOR, 0.36; 95% CI, 0.16-0.78), return of spontaneous circulation before cannulation (aOR, 0.56; 95% CI, 0.35-0.9), and acquired cardiac disease (aOR, 0.43; 95% CI, 0.29-0.64). Respiratory disease was associated with greater odds of severe neurologic complications (aOR, 1.64; 95% CI, 1.06-2.54). CONCLUSIONS: In children without CHD undergoing ECPR, we found greater odds of in-hospital mortality were associated with either obesity or trauma. The ELSO dataset also showed that other variables were associated with lesser odds of mortality, including VT as an initial arrest rhythm. Prospective studies are needed to elucidate the reasons for these survival differences.

## EXPERIMENTAL RESEARCH

**1.** Cell Mol Neurobiol. 2023 Jul;43(5):2243-2255. doi: 10.1007/s10571-022-01300-w. Epub 2022 Nov 11.

**The Neuroprotective Effects of Administration of Methylprednisolone in Cardiopulmonary Resuscitation in Experimental Cardiac Arrest Model.**

Memary E(1)(2), Imani A(3), Arhamidolatabadi A(2)(4), Fadavi P(1)(2), Aghajani M(3), Mohebzadeh F(5), Shahverdi-Shahraki M(6)(7), Dabbagh A(1)(2), Mirkheshti A(1), Shirian S(8)(9).

**ABSTRACT**

Although advances in diagnosis and treatment of cardiac arrest (CA) could improve neurological outcomes after cardiopulmonary resuscitation (CPR), survival rate and neurological outcome after CA and CPR remain poor. This study aimed to investigate the effect of epinephrine (EP) alone and EP in combination with methylprednisolone (MP) (EP + MP) on some the apoptotic and anti-apoptotic genes and proteins levels expression of the cerebral cortex as well as neuronal death in a CA rat model. Forty-five male Sprague Dawley rats were randomly divided into three groups including the hypoxic CA + EP, hypoxic CA + EP + MP, and sham groups using a simple randomization procedure. In both hypoxic CA groups, CA was induced by asphyxia and immediately after confirmation of CA, the treatment strategies including chest compression or cardiac massage simultaneously with ventilation, and administration of EP alone (20 mg/kg, every 3 min) and EP (20 mg/kg, every 3 min) + 30 (mg/kg) of MP were done. The sham group only received anesthetic drugs without CA. Some neurological outcomes were investigated using histopathological, immunohistochemical, molecular, and terminal deoxynucleotidyl transferase (TdT)-mediated dUTP nick-end labeling (TUNEL) assays at 5 and 48 h post-CPR. The data obtained showed the highest up-regulation of apoptotic genes and proteins expression, the lowest expression of anti-apoptotic gene and protein expression, the most DNA fragmentation and histopathological changes belonged to the EP group on 48 h post-CPR. While mild and intermediate histopathological changes, DNA fragmentation and apoptotic activity was detected in theEP alone and EP + MP groups at 5 h and 48 h post-CPR, respectively. As a novel finding, the present study showed that EP + MP protects neurons from death

provoked/induced by hypoxia and reperfusion injury in an experimental model of CA through up and down-regulation of pro- (caspases 3 and 8) and anti-apoptotic (BCL2) molecules, respectively.

**2.** Neuroscience. 2023 Jul 3;526:175-184. doi: 10.1016/j.neuroscience.2023.06.024. Online ahead of print.

**Mechanism of cAMP Response Element-binding Protein 1/Death-associated Protein Kinase 1 Axis-mediated Hippocampal Neuron Apoptosis in Rat Brain Injury After Cardiopulmonary Resuscitation.**

Zhou Y(1), Zhang X(2), Yang H(1), Chu B(3), Zhen M(1), Zhang J(2), Yang L(4).

**ABSTRACT**

Brain injury represents a leading cause of deaths following cardiac arrest (CA) and cardiopulmonary resuscitation (CPR). This study explores the role of CREB1 (cAMP responsive element binding protein 1)/DAPK1 (death associated protein kinase 1) axis in brain injury after CPR. CA was induced by asphyxia in rats, followed by CPR. After CREB1 over-expression, the survival rate and neurological function score of rats were measured. Nissl and TUNEL staining evaluated the pathological condition of hippocampus and apoptosis of hippocampal neurons respectively. H19-7 cells were subjected to OGD/R and infected with oe-CREB1. CCK-8 assay and flow cytometry measured the cell viability and apoptosis. CREB1, DAPK1, and cleaved Caspase-3 expressions were examined using Western blot. The binding between CREB1 and DAPK1 was determined using ChIP and dual-luciferase reporter assays. CREB1 was poorly expressed while DAPK1 was highly expressed in rat hippocampus after CPR. CREB1 overexpression improved rat neurological function, repressed neuron apoptosis, and reduced cleaved Caspase-3 expression. CREB1 was enriched on the DAPK1 promoter and suppressed DAPK1 expression. DAPK1 overexpression reversed the inhibition of OGD/R-insulted apoptosis by CREB1 overexpression. To conclude, CREB1 suppresses hippocampal neuron apoptosis and mitigates brain injury after CPR by inhibiting DAPK1 expression.

**3.** Curr Med Sci. 2023 Jul 5. doi: 10.1007/s11596-023-2695-8. Online ahead of print.

**Establishment of a Rat Model of Capillary Leakage Syndrome Induced by Cardiopulmonary Resuscitation After Cardiac Arrest.**

Zhang XL(1), Cheng Y(1), Xing CL(2), Ying JY(1), Yang X(1), Cai XD(1), Lu GP(3).

**ABSTRACT**

OBJECTIVE: Cardiopulmonary resuscitation (CPR) after cardiac arrest (CA) is one of the main causes of capillary leakage syndrome (CLS). This study aimed to establish a stable CLS model following the CA and cardiopulmonary resuscitation (CA-CPR) model in Sprague-Dawley (SD) rats. METHODS: We conducted a prospective, randomized, animal model study. All adult male SD rats were randomly divided into a normal group (group N), a sham operation group (group S), and a cardiopulmonary resuscitation group (group T). The SD rats of the three groups were all inserted with 24-G needles through their left femoral arteries and right femoral veins. In group S and group T, the endotracheal tube was intubated. In group T, CA induced by asphyxia (AACA) was caused by vecuronium bromide with the endotracheal tube obstructed for 8 min, and the rats were resuscitated with manual chest compression and mechanical ventilation. Preresuscitation and postresuscitation measurements, including basic vital signs (BVS), blood gas analysis (BG), routine complete blood count (CBC), wet-to-dry ratio of tissues (W/D), and the HE staining results after 6 h were evaluated. RESULTS: In group T, the success rate of the CA-CPR model was 60% (18/30), and CLS occurred in 26.6% (8/30) of the rats. There were no significant differences in the baseline characteristics, including BVS, BG, and CBC, among the three groups (P>0.05). Compared with pre-asphyxia, there were significant differences in BVS, CBC, and BG, including temperature, oxygen saturation (SpO2), mean arterial pressure (MAP), central venous pressure (CVP), white blood cell count (WBC), hemoglobin, hematocrit, pH,

pCO2, pO2, SO2, lactate (Lac), base excess (BE), and Na+ (P<0.05) after the return of spontaneous circulation (ROSC) in group T. At 6 h after ROSC in group T and at 6 h after surgery in groups N and S, there were significant differences in temperature, heart rate (HR), respiratory rate (RR), SpO2, MAP, CVP, WBC, pH, pCO2, Na+, and K+ among the three groups (P<0.05). Compared with the other two groups, the rats in group T showed a significantly increased W/D weight ratio (P<0.05). The HE-stained sections showed consistent severe lesions in the lung, small intestine, and brain tissues of the rats at 6 h after ROSC following AACA. CONCLUSION: The CA-CPR model in SD rats induced by asphyxia could reproduce CLS with good stability and reproducibility.

**4.** Resusc Plus. 2023 Jun 20;15:100412. doi: 10.1016/j.resplu.2023.100412. eCollection 2023 Sep.
**Hands-free continuous carotid Doppler ultrasound for detection of the pulse during cardiac arrest in a porcine model.**
Faldaas BO(1)(2), Nielsen EW(2)(3)(4)(5), Storm BS(2)(3)(4)(6), Lappegård KT(3)(7), How OJ(8), Nilsen BA(2)(4), Kiss G(9), Skogvoll E(1)(10), Torp H(1), Ingul C(1)(2).
**ABSTRACT**
BACKGROUND/PURPOSE: Pulse palpation is an unreliable method for diagnosing cardiac arrest. To address this limitation, continuous hemodynamic monitoring may be a viable solution. Therefore, we developed a novel, hands-free Doppler system, RescueDoppler, to detect the pulse continuously in the carotid artery. METHODS: In twelve pigs, we evaluated RescueDoppleŕs potential to measure blood flow velocity in three situations where pulse palpation of the carotid artery was insufficient: (1) systolic blood pressure below 60 mmHg, (2) ventricular fibrillation (VF) and (3) pulseless electrical activity (PEA). (1) Low blood pressure was induced using a Fogarty balloon catheter to occlude the inferior vena cava. (2) An implantable cardioverter-defibrillator induced VF. (3) Myocardial infarction after microembolization of the left coronary artery caused True-PEA. Invasive blood pressure was measured in the contralateral carotid artery. Time-averaged blood flow velocity (TAV) in the carotid artery was related to mean arterial pressure (MAP) in a linear mixed model. RESULTS: RescueDoppler identified pulsatile blood flow in 41/41 events with systolic blood pressure below 60 mmHg, with lowest blood pressure of 19 mmHg. In addition the absence of spontaneous circulation was identified in 21/21 VF events and true PEA in 2/2 events. The intraclass correlation coefficient within animals for TAV and MAP was 0.94 (95% CI. 0.85-0.98). CONCLUSIONS: In a porcine model, RescueDoppler reliably identified pulsative blood flow with blood pressures below 60 mmHg. During VF and PEA, circulatory arrest was rapidly and accurately demonstrated. RescueDoppler could potentially replace unreliable pulse palpation during cardiac arrest and cardiopulmonary resuscitation.

**5.** J Cereb Blood Flow Metab. 2023 Jul 19:271678X231189463. doi: 10.1177/0271678X231189463. Online ahead of print.
**Rapid, selective and homogeneous brain cooling with transnasal flow of ambient air for pediatric resuscitation.**
Koehler RC(1), Reyes M(1), Hopkins CD(1), Armstrong JS(1), Cao S(1), Kulikowicz E(1), Lee JK(1), Tandri H(2).
**ABSTRACT**
Neurologic outcome from out-of-hospital pediatric cardiac arrest remains poor. Although therapeutic hypothermia has been attempted in this patient population, a beneficial effect has yet to be demonstrated, possibly because of the delay in achieving target temperature. To minimize this delay, we developed a simple technique of transnasal cooling. Air at ambient temperature is passed through standard nasal cannula with an open mouth to produce evaporative cooling of the nasal passages. We evaluated efficacy of brain cooling with different airflows in different size piglets. Brain

temperature decreased by 3°C within 25 minutes with nasal airflow rates of 16, 32, and 16 L/min in 1.8-, 4-, and 15-kg piglets, respectively, whereas rectal temperature lagged brain temperature. No substantial spatial temperature gradients were seen along the neuroaxis, suggesting that heat transfer is via blood convection. The evaporative cooling did not reduce nasal turbinate blood flow or sagittal sinus oxygenation. The rapid and selective brain cooling indicates a high humidifying capacity of the nasal turbinates is present early in life. Because of its simplicity, portability, and low cost, transnasal cooling potentially could be deployed in the field for early initiation of brain cooling prior to maintenance with standard surface cooling after pediatric cardiac arrest.

**6.** IEEE J Biomed Health Inform. 2023 Jul 21;PP. doi: 10.1109/JBHI.2023.3297927. Online ahead of print.

**Prediction of Return of Spontaneous Circulation in a Pediatric Swine Model of Cardiac Arrest Using Low-Resolution Multimodal Physiological Waveforms.**

Silva LEV, Shi L, Gaudio H, Padmanabahn V, Morgan RW, Slovis JM, Forti RM, Morton S, Lin Y, Laurent GH, Breimann J, Yun B, Ranieri NR, Bowe M, Baker WB, Kilbaugh TJ, Ko TS, Tsui F.

**ABSTRACT**

Monitoring physiological waveforms, specifically hemodynamic variables (e.g., blood pressure waveforms) and end-tidal CO2 (EtCO2), during pediatric cardiopulmonary resuscitation (CPR) has been demonstrated to improve survival rates and outcomes when compared to standard depth-guided CPR. However, waveform guidance has largely been based on thresholds for single parameters and therefore does not leverage all the information contained in multimodal data. We hypothesize that the combination of multimodal physiological features improves the prediction of the return of spontaneous circulation (ROSC), the clinical indicator of short-term CPR success. We used machine learning algorithms to evaluate features extracted from eight low- resolution (4 samples per minute) physiological waveforms to predict ROSC. The waveforms were acquired from the 2nd to 10th minute of CPR in pediatric swine models of cardiac arrest (N = 89, 8-12kg). The waveforms were divided into segments with increasing length (both forward and backward) for feature extraction, and machine learning algorithms were trained for ROSC prediction. For the full CPR period (2nd to 10th minute), the area under the receiver operating characteristics curve (AUC) was 0.93 (95% CI: 0.87-0.99) for the multivariate model, 0.70 (0.55-0.85) for EtCO2 and 0.80 (0.67-0.93) for coronary perfusion pressure. The best prediction performances were achieved when the period from the 6th to the 10th minute was included. Poor predictions were observed for some individual waveforms, e.g., right atrial pressure. In conclusion, multimodal waveform features carry relevant information for ROSC prediction. Using multimodal waveform features in CPR guidance has the potential to improve resuscitation success and reduce mortality.

**7.** Anesthesiology. 2023 Jul 24. doi: 10.1097/ALN.0000000000004713. Online ahead of print.

**Indoleamine 2,3-Dioxygenase Deletion to Modulate Kynurenine Pathway and to Prevent Brain Injury After Cardiac Arrest in Mice.**

Magliocca A(1)(2), Perego C(2), Motta F(2), Merigo G(2), Micotti E(3), Olivari D(2), Fumagalli F(2), Lucchetti J(4), Gobbi M(4), Mandelli A(5), Furlan R(5), Skrifvars MB(6), Latini R(2), Bellani G(7)(8), Ichinose F(9)(10), Ristagno G(1)(11).

**ABSTRACT**

BACKGROUND: The catabolism of the essential amino acid tryptophan to kynurenine is emerging as a potential key pathway involved in post-cardiac arrest brain injury. The aim of this study was to evaluate the effects of the modulation of kynurenine pathway on cardiac arrest outcome, through genetic deletion of the rate-limiting enzyme of the pathway, indoleamine-2,3-dyoxygenase(IDO). METHODS: Wild-type (WT) and IDO-deleted (IDO -/-) mice were subjected to 8 min cardiac arrest.

Survival, neurological outcome, and locomotor activity were evaluated following resuscitation. Brain magnetic resonance imaging with diffusion tensor and diffusion-weighted imaging sequences was performed, together with microglia/macrophage activation and neurofilament light chain measurements. RESULTS: IDO-/- mice showed higher survival compared to WT mice (IDO-/- 11/16, WT 6/16, log-rank p=0.036). Neurological function was higher in IDO-/- mice than in WT mice following cardiac arrest (IDO-/- 9±1, WT 7±1, p=0.012, n=16). IDO-deletion preserved locomotor function while maintaining physiologic circadian rhythm after cardiac arrest. Brain magnetic resonance imaging with diffusion tensor imaging showed an increase in mean fractional anisotropy in the corpus callosum (IDO-/- 0.68±0.01, WT 0.65±0.01, p=0.010, n=5-4) and in the external capsule (IDO -/- 0.47±0.01, WT 0.45±0.01, p=0.006, n=5-4) in IDO-/- mice compared to WT ones. Increased release of neurofilament light chain was observed in WT mice compared to IDO-/- (median concentrations (IQR), pg/mL: WT 1138 (678-1384), IDO-/- 267 (157-550), p<0.001, n=3-4).Brain magnetic resonance imaging with diffusion-weighted imaging revealed restriction of water diffusivity 24 hours after cardiac arrest in WT mice, IDO-deletion prevented water diffusion abnormalities, which was reverted in IDO-/- mice receiving L-kynurenine (Apparent Diffusion Coefficient, μm2/ms: WT 0.48±0.07, IDO-/- 0.59±0.02, IDO-/- +L-Kynurenine 0.47±0.08, p=0.007, n=6). CONCLUSIONS: Kynurenine pathway represents a novel target to prevent post-cardiac arrest brain injury. The neuroprotective effects of IDO-deletion were associated with preservation of brain white matter microintegrity and with reduction of cerebral cytotoxic edema.

**8.** Resusc Plus. 2023 Jul 14;15:100429. doi: 10.1016/j.resplu.2023.100429. eCollection 2023 Sep.
**Left rib fractures during cardiopulmonary resuscitation are associated with hemodynamic variations in a pig model of cardiac arrest.**
Jaeger D(1)(2), Kalra R(1), Sebastian P(1), Gaisendrees C(1)(3), Kosmopoulos M(1), Debaty G(1)(4), Chouihed T(2), Bartos J(1), Yannopoulos D(1).
**ABSTRACT**
BACKGROUND: Chest compressions (CC) are the cornerstone of cardiopulmonary resuscitation (CPR). But CC are also known to cause injuries, specifically rib fractures. The effects of such fractures have not been examined yet. This study aimed to investigate hemodynamic effects of rib fractures during mechanical CPR in a porcine model of cardiac arrest (CA). METHODS: We conducted a retrospective hemodynamic study in 31 pigs that underwent mechanical CC. Animals were divided into three groups based on the location of rib fractures: No Broken Ribs group (n = 11), Left Broken Ribs group (n = 13), and Right Broken Ribs group (n = 7). Hemodynamic measurements were taken at 10 seconds before and 10, 30, and 60 seconds after rib fractures. RESULTS: Baseline hemodynamic parameters did not differ between the three groups. Systolic aortic pressure was overall higher in the Left Broken Ribs group than in the No Broken Ribs group at 10, 30, and 60 seconds after rib fracture (p = 0.02, 0.01, and 0.006, respectively). The Left Broken Ribs group had a significantly higher right atrial pressure compared to the No Broken Rib group after rib fracture (p = 0.02, 0.01, and 0.03, respectively). There was no significant difference for any parameter for the Right Broken Ribs group, when compared to the No Broken Ribs group. CONCLUSION: An increase in main hemodynamic parameters was observed after left rib fractures while right broken ribs were not

associated with any change in hemodynamic parameters. Reporting fractures and their location seems worthwhile for future experimental studies.

**9.** Purinergic Signal. 2023 Jul 29. doi: 10.1007/s11302-023-09958-7. Online ahead of print.
**The role of pyruvate-induced enhancement of oxygen metabolism in extracellular purinergic signaling in the post-cardiac arrest rat model.**
Shinozaki K(1)(2)(3), Wong V(4), Aoki T(4), Hayashida K(4), Takegawa R(4), Endo Y(4), Nandurkar H(5), Diamond B(4), Robson SC(6), Becker LB(4)(7).
**ABSTRACT**
Purine nucleotide adenosine triphosphate (ATP) is a source of intracellular energy maintained by mitochondrial oxidative phosphorylation. However, when released from ischemic cells into the extracellular space, they act as death-signaling molecules (eATP). Despite there being potential benefit in using pyruvate to enhance mitochondria by inducing a highly oxidative metabolic state, its association with eATP levels is still poorly understood. Therefore, while we hypothesized that pyruvate could beneficially increase intracellular ATP with the enhancement of mitochondrial function after cardiac arrest (CA), our main focus was whether a proportion of the raised intracellular ATP would detrimentally leak out into the extracellular space. As indicated by the increased levels in systemic oxygen consumption, intravenous administrations of bolus (500 mg/kg) and continuous infusion (1000 mg/kg/h) of pyruvate successfully increased oxygen metabolism in post 10-min CA rats. Plasma ATP levels increased significantly from 67 ± 11 nM before CA to 227 ± 103 nM 2 h after the resuscitation; however, pyruvate administration did not affect post-CA ATP levels. Notably, pyruvate improved post-CA cardiac contraction and acidemia (low pH). We also found that pyruvate increased systemic CO2 production post-CA. These data support that pyruvate has therapeutic potential for improving CA outcomes by enhancing oxygen and energy metabolism in the brain and heart and attenuating intracellular hydrogen ion disorders, but does not exacerbate the death-signaling of eATP in the blood.

## CASE REPORTS

**1.** World J Clin Cases. 2023 Jun 16;11(17):4133-4141. doi: 10.12998/wjcc.v11.i17.4133.
**Massive pulmonary embolism in Klippel-Trenaunay syndrome after leg raising: A case report.**
Lo CY(1), Chen KB(2), Chen LK(1), Chiou CS(3).
**ABSTRACT**
BACKGROUND: Klippel-Trenaunay syndrome (KTS) is a rare congenital disorder characterized by a combination of capillary malformations, soft-tissue or bone hypertrophy, and varicose veins or venous malformations. The syndrome predisposes patients to hypercoagulable states, including venous thromboembolism and pulmonary embolism (PE). CASE SUMMARY: A 12-year-old girl with KTS was scheduled excision of verrucous hyperkeratosis in the left foot and posterior aspect of the left leg and left thigh and excision of a cutaneous hemangioma in the right buttock. After induction, the surgeon elevated the patient's leg for sterilization, whereupon she experienced a massive PE and refractory cardiac arrest. Extracorporeal membrane oxygenation (ECMO) was performed after prolonged resuscitation, and she had a return of spontaneous circulation. After this episode, the patient was discharged without any neurologic complications. CONCLUSION: The mechanism of PE, a lethal disease, involves a preexisting deep vein thrombosis that is mechanically dislodged by compression or changing positions and travels to the pulmonary artery. Therefore, patients predisposed to PE should be prescribed prophylactic anticoagulants. If the patient has unstable vital signs, resuscitation should be started immediately, and extracorporeal cardiopulmonary

resuscitation should be considered in settings with existing ECMO protocols, expertise, and equipment. Awareness of PE in patients with KTS while leg raising for sterilization is critical.

**2.** Medicina (B Aires). 2023;83(3):467-470.
**[Barlow syndrome: A rare etiology of sudden death].**
[Article in Spanish; Abstract available in Spanish from the publisher]
Fernandez Villar G(1), Delgado Gaete M(2), Lillo E(2), Scattini C(2), Arias A(2), Pizarro R(2).
**ABSTRACT**
We present the case of a 60-year-old woman, with a history of mitral valve prolapse, who consulted for dyspnea and palpitations of 2 weeks of evolution up to functional class IV. The admission electrocardiogram showed a moderately responsive atrial fibrillation rhythm with frequent ventricular extra systoles. A transthoracic echocardiogram was performed which showed mitral valve prolapse with severe impairment of ventricular function. Barlow syndrome was diagnosed. During hospitalization, the patient presented three episodes of cardiorespiratory arrest that were reversed with advanced cardiopulmonary resuscitation maneuvers. During admission, a negative balance was performed, sinus rhythm was reverted and an implantable automatic defibrillator was placed in secondary prevention. During follow-up, severe deterioration of ventricular function persisted. We highlight Barlow syndrome as a rare cause of sudden death and its association with dilated cardiomyopathy.

**3.** Cardiovasc Revasc Med. 2023 Jun 24:S1553-8389(23)00669-3. doi: 10.1016/j.carrev.2023.06.023. Online ahead of print.
**Cardiogenic shock in a young woman with SCAD: The importance of early access to VA-ECMO in the community.**
Ya'Qoub L(1), Alqarqaz M(2), Cowger J(2), Nemeh H(3), Basir MB(2), Alaswad K(2), Koenig G(2).
**ABSTRACT**
Spontaneous coronary artery dissection (SCAD) is a common cause of myocardial infarction in young and middle-aged women. Patients with SCAD present rarely with hemodynamic collapse and cardiogenic shock, requiring immediate resuscitation and mechanical circulatory support. Percutaneous mechanical circulatory support may serve as a bridge to recovery, decision or heart transplantation. We present a case of a young woman with SCAD of the left main coronary artery, presenting with ST-elevation myocardial infarction, cardiac arrest and cardiogenic shock. She was stabilized emergently with Impella and early escalation with extracorporeal membrane oxygenation (ECPELLA) at a non-surgical community hospital. Despite revascularization with percutaneous coronary intervention (PCI), her left ventricular recovery was poor, and ultimately required cardiac transplantation on day 5 of her presentation.

**4.** Front Cardiovasc Med. 2023 Jun 8;10:1200553. doi: 10.3389/fcvm.2023.1200553. eCollection 2023.
**Extracorporeal membrane oxygenation for acute pulmonary embolism after postoperative craniocerebral trauma: a case report.**
Liao X(1), Chen X(2), Zhong S(1), Wen J(1), Li B(1).
**ABSTRACT**
INTRODUCTION: Massive pulmonary embolism (PE) is a life-threatening complication of major surgery with a mortality rate of up to 50%. Extracorporeal membrane oxygenation (ECMO) is primarily used for respiratory and circulatory support. Venoarterial extracorporeal membrane oxygenation (VA-ECMO) is used to stabilize patients with acute massive PE. Acute brain injury, vascular disease, and immunosuppression are contraindications to ECMO, as stated in the 2021

Extracorporeal Life Support Organization guidelines. CASE SUMMARY: We report a case of a patient with craniocerebral trauma whose postoperative course was complicated by massive PE and subsequent cardiac arrest that required urgent VA-ECMO, followed by anticoagulation with heparin. The patient showed hemodynamic improvement and was discharged 68 days after hospitalization. DISCUSSION: ECMO has gradually been accepted for patients with craniocerebral injuries. The safety and effectiveness of ECMO in patients with craniocerebral injury, along with the optimal duration of ECMO and anticoagulation strategies, require further study.

**5.** Clin Case Rep. 2023 Jun 22;11(6):e7448. doi: 10.1002/ccr3.7448. eCollection 2023 Jun.
**Cardiopulmonary arrest upon admission caused by pilsicainide hydrochloride intoxication: A case report.**
Takahashi Y(1), Matsuura H(1), Hino H(1), Chujoh S(1), Kishimoto M(1).
**ABSTRACT**
A 22-year-old male presented to our hospital after receiving 2450 mg of pilsicainide hydrochloride. Subsequently, he experienced cardiac arrest, and percutaneous cardiopulmonary support was introduced to maintain his circulation. After 3 days of intensive care, he regained consciousness and was transferred to another hospital for treatment related to psychological problems.

**6.** J Osteopath Med. 2023 Jun 29. doi: 10.1515/jom-2023-0097. Online ahead of print.
**Sudden cardiac death in a young male endurance athlete.**
Seely KD(1), Crockett KB(1), Nigh A(1).
**ABSTRACT**
Sudden cardiac death (SCD) is a rare yet devastating event that can occur in young athletes. Although hypertrophic obstructive cardiomyopathy is the most common cause of SCD, some other genetic abnormalities have been identified as proarrhythmic. However, there is not routine screening for these other genetic abnormalities. Furthermore, consumption of caffeine, stimulant medication, or prolonged exercise can potentiate the underlying arrhythmic potential. In the event of SCD, advanced cardiac life support (ACLS) should be performed immediately and exactly. The authors present a case of an otherwise healthy young male who collapsed during a marathon and could not be resuscitated despite aggressive measures. After aggressive resuscitative efforts, the patient ultimately expired. A postmortem autopsy revealed no cardiac structural abnormalities, and the cause of death was determined to be cardiac arrhythmia of undetermined etiology. Postmortem genetic testing revealed a heterozygous variation in calcium voltage-gated channel auxiliary subunit beta 2 (CACNB2), a gene associated with arrhythmia and calcium channelopathy. Toxicology showed therapeutic levels of amphetamine. This case highlights the eminent risk of cardiac death in young athletes with proarrhythmic genetic variations, especially in the setting of endurance sport.

**7.** Cureus. 2023 Jun 5;15(6):e39986. doi: 10.7759/cureus.39986. eCollection 2023 Jun.
**Pheochromocytoma and Hypertrophic Cardiomyopathy Leading to Cardiac Arrest.**
Niu K(1), Ghumra A(1), Mirza B(1), Dreier J(2).
**ABSTRACT**
A 33-year-old female with no known past medical history presented to the hospital for a witnessed cardiac arrest. The patient was emergently intubated and sedated. Further investigation demonstrated an 8.5 cm x 7.6 cm mass in the adrenal region, which was subsequently found to be a pheochromocytoma by biopsy. She was transferred to a tertiary care center for further evaluation. We wish to raise awareness of this condition among clinicians and encourage further research into the connections between pheochromocytoma and further cardiac complications.

**8.** Acute Med Surg. 2023 Jul 3;10(1):e867. doi: 10.1002/ams2.867. eCollection 2023 Jan-Dec.
**A pediatric case of multiple trauma with impending cardiac arrest due to hemorrhagic shock successfully treated with resuscitative thoracotomy: A case report.**
Hojo K(1)(2), Abe T(1)(3), Saito K(1), Sasaki A(1), Ochiai H(1).
**ABSTRACT**
BACKGROUND: The effectiveness of resuscitative thoracotomy (RT) in pediatric patients with multiple trauma is limited. We present a pediatric case of multiple trauma successfully treated with RT. CASE PRESENTATION: A 9-year-old boy was injured after falling down stairs. On arrival, his blood pressure was unmeasurable, and the carotid artery pulse was barely palpable. Sonographic assessment indicated intra-abdominal hemorrhage. RT and aortic cross-clamping were performed, and he received a blood transfusion, after which his circulatory status recovered. Laparotomy indicated an inferior mesenteric vein injury that was sutured. Ten hours after arrival, an acute epidural hematoma was observed and treated with an emergency craniotomy. The patient's condition remained stable and he was discharged on the 101st day. CONCLUSION: RT may save the life of patients with multiple trauma, even pediatric patients, if performed in a timely manner, based on the diagnosis of hemorrhagic shock, along with rapid transfusion and hemostatic intervention.

**9.** J Clin Med. 2023 Jun 25;12(13):4249. doi: 10.3390/jcm12134249.
**Early Application of ECMO after Sudden Cardiac Arrest to Prevent Further Deterioration: A Review and Case Report.**
Kiss B(1), Nagy B(1), Pál-Jakab Á(1), Lakatos B(1), Soltész Á(1), Osztheimer I(1), Heltai K(1), Édes IF(1), Németh E(1), Merkely B(1), Zima E(1).
**ABSTRACT**
ECMO has become a therapeutic modality for in- and out-of-hospital scenarios and is also suitable as a bridging therapy until further decisions and interventions can be made. Case report: A 27-year-old male patient with mechanical aortic valve prothesis had a sudden cardiac arrest (SCA). ROSC had been achieved after more than 60 min of CPR and eight DC shocks due to ventricular fibrillation (VF). The National Ambulance Service unit transported the patient to our clinic for further treatment. Due to the trauma and therapeutic INR, a CT scan was performed and ruled out bleeding. Echocardiography described severely decreased left ventricular function. Coronary angiography was negative. Due to the therapeutic refractory circulatory and respiratory failure against intensive care, VA-ECMO implantation was indicated. After four days of ECMO treatment, the patient's circulation was stabilized without neurological deficit, and the functions of the end organs were normalized. Cardiac MRI showed no exact etiology behind SCA. ICD was implanted due to VF and SCA. The patient was discharged after 19 days of hospitalization. Conclusion: This case report points out that the early application of mechanical circulatory support could be an outcome-determinant therapeutic modality. Post-resuscitation care includes cardiorespiratory stabilization, treatment of reversible causes of malignant arrhythmia, and secondary prevention.

**10.** Front Cardiovasc Med. 2023 Jun 22;10:1164076. doi: 10.3389/fcvm.2023.1164076. eCollection 2023.
**Successful cardiopulmonary resuscitation of cardiac arrest induced by massive pulmonary embolism under general anesthesia: a case report.**
Li Z(1), Cai N(1).
**ABSTRACT**
BACKGROUND: While pulmonary embolism (PE) is a common occurrence, a large life-threatening PE is not. Herein, we discuss the case of a patient with a life-threatening PE that occurred under general anesthesia. CASE PRESENTATION: We present the case of a 59-year-old male patient who was at bed

rest for several days due to trauma, which resulted in femoral and rib fractures and a lung contusion. The patient was scheduled for femoral fracture reduction and internal fixation under general anesthesia. After disinfection and surgical towel laying, there was a sudden occurrence of severe PE and cardiac arrest; the patient was successfully resuscitated. Computed tomography pulmonary angiography (CTPA) was performed to confirm the diagnosis, and the patient's condition improved after thrombolytic therapy. Unfortunately, the patient's family eventually discontinued treatment. DISCUSSION: Massive PE frequently occurs suddenly, may endanger a patient's life at any point in time, and cannot be diagnosed quickly on the basis of clinical manifestations. Although the vital signs fluctuate greatly and there is insufficient time to conduct more tests, some factors such as special disease history, electrocardiography, end-tidal carbon dioxide, and blood gas analysis may help us determine the preliminary diagnosis; however, the final diagnosis is made using CTPA. Current treatment options include thrombectomy, thrombolysis, and early anticoagulation, of which thrombolysis and early anticoagulation are the most feasible. CONCLUSION: Massive PE is a life-threatening disease that requires early diagnosis and timely treatment to save patients' lives.

**11.** BMJ Case Rep. 2023 Jul 10;16(7):e253421. doi: 10.1136/bcr-2022-253421.
**Management of a complex acetabular fracture following defibrillation for ventricular fibrillation cardiac arrest.**
Watson S(1)(2), Bampouri T(2), El-Daly I(3), O'Gallagher K(4)(2).
**ABSTRACT**
In this case report, we describe the first case of a patient who sustained a complex acetabular fracture following defibrillation for ventricular fibrillation cardiac arrest in the context of acute myocardial infarction. The patient was unable to undergo definitive open reduction internal fixation surgery due to the need to continue dual antiplatelet therapy following coronary stenting of his occluded left anterior descending artery. Following multidisciplinary discussions, a staged approach was opted for, with percutaneous closed reduction screw fixation of the fracture performed while the patient was maintained on dual antiplatelet therapy. The patient was discharged with a plan to perform definitive surgical management when safe to discontinue dual antiplatelets. This is the first confirmed case of defibrillation causing an acetabular fracture. We discuss the various aspects that need to be considered when patients are being worked up for surgery while on dual antiplatelet therapy.

**12.** Forensic Sci Med Pathol. 2023 Jul 14. doi: 10.1007/s12024-023-00670-x. Online ahead of print.
**Sudden death of a 12-year-old boy with severe myocardial fibrosis due to inapparent chronic myocarditis.**
Madea B(#)(1), Duval I(#)(1), Doberentz E(2).
**ABSTRACT**
Sudden death due to unknown cardiac disease in children is an unusual occurrence. An apparently healthy 12-year-old boy without any physical restrictions collapsed suddenly and died despite cardiopulmonary resuscitation. The main autopsy finding was extensive scarring of the myocardium, especially the interventricular septum. This extensive scarring was exceptional for the young age. Histologically, replacement-type fibrosis with patchy lymphomonocytic infiltrate and infiltration by macrophages were observed. The case was diagnosed as chronic myocarditis, which may have progressed to dilated cardiomyopathy with inflammation or inflammatory cardiomyopathy.

**13.** JBJS Case Connect. 2023 Jul 21;13(3). doi: 10.2106/JBJS.CC.23.00107. eCollection 2023 Jul 1.
**Thoracic Spine Fracture After Cardiopulmonary Resuscitation in a Patient with Ankylosing Spondylitis: A Case Report.**

de Los Cobos D(1), Nwadike BA, Padhye K.

**ABSTRACT**

CASE: A 32-year-old man with a history of ankylosing spondylitis presented to the emergency department because of sepsis secondary to Fournier's gangrene and subsequently went into cardiac arrest requiring cardiopulmonary resuscitation (CPR). On the twelfth hospital day, a fracture through the T5-T6 intervertebral disk space was incidentally found on a chest, abdominal, and pelvic Computed Tomography (CT) scan. The rounds of CPR were the only traumatic event that the patient underwent before the discovery of the spine fracture. CONCLUSION: A low threshold for advanced imaging should be held to rule out occult spine fractures in patients with ankylosed spines after receiving CPR.

**14.** Cureus. 2023 Jun 15;15(6):e40465. doi: 10.7759/cureus.40465. eCollection 2023 Jun.

**A Rare Phenomenon of Pulseless Body Movements Induced During Prolonged Cardiopulmonary Resuscitation.**

Ilyas WM(1), Gadkari C(1), Singh A(2), Chavan G(1).

**ABSTRACT**

Patients receiving cardiopulmonary resuscitation (CPR) may rarely experience cardiopulmonary resuscitation-induced consciousness (CPRIC), manifesting as body movements, eye-opening, or even awareness. We present a case report of a 55-year-old male patient who experienced CPRIC but did not survive despite resuscitative measures. The patient suffered a sudden cardiac arrest and received early initiation of CPR. However, CPRIC posed a treatment dilemma for our resuscitation team as the patient displayed body movements, requiring careful management to avoid interruptions in CPR. The challenge of differentiating CPRIC from the return of spontaneous circulation (ROSC) highlights the need for further research and evidence-based guidelines. Effective management strategies for CPRIC are necessary to guide resuscitation teams in making informed decisions. Understanding and addressing CPRIC can improve the quality of CPR and post-resuscitation care, supporting the well-being of both patients and healthcare providers. Further investigation is essential to developing comprehensive approaches to managing CPRIC and improving patient outcomes.

**15.** Am J Cardiol. 2023 Jul 24:S0002-9149(23)00396-X. doi: 10.1016/j.amjcard.2023.06.027. Online ahead of print.

**Commotio Cordis Returns…When We Least Expected It: Cardiac Arrest in A Professional Football Player.**

Maron BJ(1), Estes NAM(2).

**ABSTRACT**

For the first time in 52 years, an American professional football player (Damar Hamlin) collapsed in cardiac arrest during a game, viewed in real-time on national television. The cause of this profound event was commotio cordis, that is, blunt non-penetrating chest blow-initiated ventricular fibrillation triggered by physical contact not considered unusual for football. The athlete survived because of timely cardiopulmonary resuscitation and defibrillation provided by first responders organized by the National Football League. Commotio cordis, albeit rare, was most prominently identified initially in competitive and also recreational sports participants. More recently it became apparent that similar events could occur in almost any circumstance involving a chest blow, such as during everyday activities around the home and with innocent play. The determinant of a commotio cordis event is a blow over the heart in a narrow vulnerable electrical window during dispersion of repolarization. Survival from these events has increased substantially to >60% due to enhanced recognition and prompt resuscitation/defibrillation. In conclusion, in this commentary, we take a

timely opportunity to describe in detail the relevant demographics, mechanism/pathophysiology, and clinical course of commotio cordis.

**16.** Pak J Med Sci. 2023 Jul-Aug;39(4):1208-1211. doi: 10.12669/pjms.39.4.7193.
**Post-Cardiac arrest targeted temperature management in a parturient with severe COVID-19 disease.**
Eman A(1), Balaban O(2), Süner KÖ(3), Özgün B(4).
**ABSTRACT**
BACKGROUND AND OBJECTIVE: Targeted temperature management (TTM) may improve neurological outcomes and mortality after cardiac arrest. We present a targeted mild hypothermia treatment in a postpartum patient with COVID-19 after successful cardiopulmonary resuscitation (CPR). CASE PRESENTATION: A 23 year old, 26-week pregnant patient with the diagnosis of COVID-19. The patient developed respiratory arrest followed by cardiac arrest and underwent CPR for six minutes. The patient underwent an emergency cesarean section after CPR in intensive care unit. After the resuscitation, 72-hours hypothermia protocol was initiated. We extubated the patient 13 days after the hypothermia procedure. The patient was conscious and cooperative. Respiratory distress worsened in the following days; the patient was re-intubated 18 days after the TTM. The benefit of targeted hypothermia was improved neurologic outcome in our patient. However, severe infectious complications led to multi-organ failure and the patient died on the 45th ICU admission day.

**17.** Cureus. 2023 Jun 23;15(6):e40855. doi: 10.7759/cureus.40855. eCollection 2023 Jun.
**Cardiac Arrest as the Initial Presentation of Undiagnosed Kawasaki Disease: A Case Report and Literature Review.**
Sliem A(1), Siu A(1), Zheng J(1), Magana S(1), Alagha Z(2), Ghallab M(3), Lopez M(4).
**ABSTRACT**
Kawasaki Disease (KD) is a self-limited acute vasculitis that mainly affects medium-sized arteries in childhood, with the coronary arteries being one of the main targets. A well-known complication is a coronary aneurysm with myocardial ischemia. We report the case of a 29-year-old female with an insignificant past medical history who presented with sudden cardiac arrest. Labs were significant for elevated troponin, consistent with non-ST elevation myocardial infarction, given diffuse ST depression on the electrocardiogram. The patient underwent a coronary angiogram that revealed diffuse coronary artery disease with multiple ulcerations, aneurysms, and occlusions consistent with KD, despite denying prior history. Cardiac arrest may be the initial presentation of undiagnosed KD and should be considered as one of the differential diagnoses.

**18.** Eur Heart J Case Rep. 2023 Jul 12;7(7):ytad307. doi: 10.1093/ehjcr/ytad307. eCollection 2023 Jul.
**Catheter-directed mechanical thrombectomy in a patient with high-risk pulmonary embolism complicated by out-of-hospital cardiac arrest: a case report.**
Thangavel S(1), Korsholm K(1), Veien KT(1), Larsen KM(2), Andersen A(1).
**ABSTRACT**
BACKGROUND: Pulmonary embolism (PE) is common, and it is the third leading cause of cardiovascular death. The management of patients with high-risk PE generally consists of systemic thrombolysis; however, surgical or catheter-directed treatment (CDT) can be considered in selected cases. CASE SUMMARY: A 78-year-old female patient presenting with acute severe dyspnoea develops out-of-hospital cardiac arrest (OHCA). She was admitted with return of spontaneous circulation and a critical haemodynamic state upon arrival to the catheterization laboratory with an estimated no-flow time of 1 min and low-flow time of 52 min. An acute pulmonary angiogram

reveals massive PE. After a PE response team conference, the patient was not found eligible for extracorporeal membrane oxygenation, surgery, or thrombolysis. The patient was treated with catheter-directed mechanical thrombectomy 129 min after first medical contact. The patient recovered and was discharged without any neurological deficits. DISCUSSION: Catheter-directed mechanical thrombectomy was a successful treatment in a patient with OHCA secondary to high-risk PE, where thrombolysis and surgical interventions were considered contraindicated. This case underlines the future perspectives of CDT and also that a multidisciplinary team approach may benefit patients with high-risk PE.

**19.** Clin Trials. 2023 Jul 24:17407745231188443. doi: 10.1177/17407745231188443. Online ahead of print.

**Randomized controlled dose-escalation design to evaluate the safety of a novel pharmacological cardiopulmonary resuscitation strategy.**

Benson S(1), Yannopoulos D(2), Aufderheide TP(3), Murray TA(1).

**ABSTRACT**

BACKGROUND/AIMS: The motivating randomized controlled phase I trial evaluates three sodium nitroprusside doses in a novel sodium nitroprusside-enhanced cardiopulmonary resuscitation strategy for improved end-organ perfusion relative to local standard of care. Sodium nitroprusside is a vasodilator with an established safety profile in other indications, whereas the local standard of care uses vasoconstrictors, typically epinephrine. The purpose of the proposed trial is to identify the highest safe dose of sodium nitroprusside in this new context as excessive doses may cause severe hypotension with compromised end-organ perfusion. METHODS: The proposed phase I trial design expands upon traditional dose-finding designs to include a randomized control arm, which is needed to assess safety through the relative increase in serum lactate on hospital admission. For guiding dose escalation, we propose and compare six Bayesian models which characterize expected serum lactate as a function of sodium nitroprusside dose and randomization group. Each model makes a different assumption about the expected change in serum lactate across control cohorts concurrently randomized with each dose. Model selection aims to minimize the expected number of times that a dose is incorrectly classified as safe or unsafe while sample size selection targets an expected number of incorrectly classified doses. Randomization is 1:1 for the initial cohort, and for subsequent cohorts is chosen to maximize the lower confidence bound. RESULTS: The spike-and-slab model minimizes the expected number of times that a dose is incorrectly classified as safe or unsafe under the most scenarios in the motivating three-dose trial, but all six models exhibit relatively similar performance. A 2:1 randomization ratio for the second and third cohorts maximizes the lower confidence bound when using the spike-and-slab model. With the optimal design, on average, 70 individuals will ensure 1 incorrectly classified dose in 6 opportunities. CONCLUSION: We recommend that the motivating trial use the spike-and-slab model with a 1:1 randomization ratio for the initial cohort and 2:1 randomization ratio for subsequent cohorts; however, the simpler fixed effects approaches performed similarly well.

**20.** Am J Emerg Med. 2023 Aug;70:211.e1-211.e3. doi: 10.1016/j.ajem.2023.02.015. Epub 2023 Feb 14.

**Rapid administration of Kcentra® during cardiopulmonary arrest.**

White K(1), Gagnon Z(2), Cocchio C(2).

**ABSTRACT**

We present a case of cardiopulmonary arrest secondary to rivaroxaban related oropharyngeal hemorrhage, which required rapid intravenous (IV) push administration of 4-factor prothrombin

complex concentrate (4F-PCC). Manufacturers recommend administering 4F-PCC IV at a rate of 0.12 mL/kg/min (approximately 3 units/kg/min) up to a maximum rate of 8.4 mL/min (approximately 210 units/min) [1]. The concern with rapid administration is increased potential for thromboembolic complications. There have been small studies assessing infusion rates greater than the manufacturer's recommendation with few reported thromboembolic events [2-5]. Our patient was an 81-year-old female presenting to the emergency department (ED) with sudden onset oropharyngeal hemorrhage. The patient had a pertinent history of oral and esophageal cancer and was prescribed rivaroxaban 20 mg once daily for treatment of deep vein thrombosis. Within moments of the patient arriving, she produced a large volume of blood from her nose and mouth. The source of the bleeding could not be determined, and as suctioning was attempted to clear her airway, the patient became unresponsive and pulseless. Advanced Cardiac Life Support (ACLS) procedures were initiated and 1000 mg of tranexamic acid were administered. Once the patient's active medication list was discovered, 2000 units of 4F-PCC was given as an IV push over roughly 20 s. Bleeding was controlled enough to secure the patient's airway within 5 min after 4F-PCC administration and subsequently return of spontaneous circulation was achieved. Unfortunately, the patient suffered a poor neurologic outcome and the family withdrew care after discussion with the treatment team and the patient's oncologist. This case report demonstrates rapid administration of 4F-PCC may be an effective intervention to treat immediately life threatening rivaroxaban related bleeding.

**21.** Am J Case Rep. 2023 Jul 24;24:e939771. doi: 10.12659/AJCR.939771.

**Partial Hepatectomy of a VA-ECMO Patient After Mechanical CPR by LUCAS Device Due to a Catastrophic Liver Laceration: A Case Report.**

Grinberg R(1), Minha S(2), Shapira Z(3), Rapoport A(1), Golman N(1), Hochman Y(1), Miltau D(1), Hai Y(1), Ilgiyaev E(1).

**ABSTRACT**

BACKGROUND Many patients experiencing acute coronary syndrome (ACS) present in cardiac arrest. Mechanical chest compressions are a common tool in cardiopulmonary resuscitation (CPR) and have their benefits as well as disadvantages and reported complications. In recent years, veno-arterial extracorporeal oxygenation membrane (VA-ECMO) has proven to be a promising tool in these circumstances and is now considered part of the treatment algorithm in emergent and refractory cases. The combination of mechanical compressions and the ECMO lead to "new" complicated situations in the patients. We discuss such a patient, who required emergent surgery due to complications from his resuscitation, while under ECMO. CASE REPORT A 56-year-old man, with medical history of cardiovascular risk factors, presented to our facility due to ST segment elevation myocardial infarction. During his catheterization, he went into cardiac arrest and needed cardio-pulmonary resuscitation (CPR) using a LUCAS3™ device. Because no rhythm was restored, he was promptly placed on VA-ECMO support with immediate, albeit transient, stabilization. After transportation to our Intensive Care Unit (ICU), he quickly deteriorated again hemodynamically and after imaging workup it was discovered he had a major laceration to his liver and was rushed emergently to the operating room where he underwent partial hepatectomy, while on full anticoagulation due to the ECMO support. CONCLUSIONS Complications from mechanical CPR are common, including liver laceration. Patients who are placed on ECMO following such measures should be carefully evaluated for such complications as they might affect the treatment and prognosis.