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The present and future of cardiac arrest care – international experts reach out to caregivers and healthcare authorities

Nolan JP, Berg RA, Callaway CW, Morrison LJ, Nadkarni V, Perkins GD, Sandroni C, Skrifvars MB, Soar J, Sunde K, Cariou A.

Jerry P. Nolan
School of Clinical Sciences
University of Bristol
Consultant in Anaesthesia and Intensive Care Medicine
Royal United Hospital,
Bath, UK
jerry.nolan@nhs.net

Robert A. Berg
Division Chief, Pediatric Critical Care Medicine
Russell Raphaely Endowed Chair of Critical Care Medicine
The Children's Hospital of Philadelphia
Professor of Anesthesiology and Critical Care Medicine
The University of Pennsylvania Perelman School of Medicine
bergra@email.chop.edu

Clifton W. Callaway
Department of Emergency Medicine
University of Pittsburgh School of Medicine
Pittsburgh, PA
USA
callawaycw@upmc.edu

Laurie J. Morrison
Rescu,
St.Michael's Hospital,
30 Bond St,
Toronto, ON M5B 1W8,

Canada,
E-mail morrisonl@smh.ca

Vinay Nadkarni
Endowed Chair, Professor, Department of Anesthesia and Critical Care Medicine
The Children's Hospital of Philadelphia
3401 Civic Center Blvd, Philadelphia,
PA 19104, USA
NADKARNI@email.chop.edu

Gavin D. Perkins
Professor of Critical Care Medicine
University of Warwick, Warwick Medical School and Heart of England NHS
Foundation Trust, Coventry, CV4 7AL
g.d.perkins@warwick.ac.uk

Claudio Sandroni
Istituto Anestesiologia e Rianimazione Università Cattolica del Sacro Cuore
Fondazione Policlinico Universitario "Agostino Gemelli"
Largo Francesco Vito, 1 – 00168 Rome, Italy
email: claudio.sandroni@policlinicogemelli.it

Markus B Skrifvars
Professor of Pre-hospital Emergency Medicine
Division of Intensive Care
Department of Anaesthesiology, Intensive Care and Pain Medicine
Helsinki University Hospital and University of Helsinki
Haartmaninkatu 4
00029 HUS, Finland
markus.skrifvars@hus.fi

Jasmeet Soar
Consultant in Intensive Care Medicine
Southmead Hospital

North Bristol NHS Trust
Bristol, BS10 5NB, UK
jasmeet.soar@nbt.nhs.uk

Kjetil Sunde
Department of Anaesthesiology
Division of Emergencies and Critical Care
Oslo University Hospital and
Institute of Clinical Medicine
University of Oslo
Oslo, Norway
kjetil.sunde@medisin.uio.no

Alain Cariou
Medical ICU, Cochin Hospital (AP-HP); Paris-Cardiovascular-Research-Centre,
INSERM U970 (Sudden Death Expertize Centre);
Université Paris-Descartes-Sorbonne-Paris-Cité, Paris, France
alain.cariou@cch.aphp.fr

Correspondence to J.P. Nolan (jerry.nolan@nhs.net)

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[h1]Abstract

[h2] Purpose

The purpose of this review is to describe the epidemiology of out-of-hospital cardiac arrest (OHCA), disparities in organisation and outcome, recent advances in treatment and ongoing controversies. We also outline the standard of care that should be provided by the critical care specialist and propose future directions for cardiac arrest research.

[h2] Methods

Narrative review with contributions from international resuscitation experts

[h2] Results

Although it is recognised that survival rates from OHCA are increasing there is considerable scope for improvement and many countries have implemented national strategies in an attempt to achieve this goal. More resources are required to enable high-quality randomised trials in resuscitation.

[h2] Conclusion

Increasing international collaboration should facilitate resuscitation research and knowledge translation. The International Liaison Committee on Resuscitation (ILCOR) has adopted a continuous evidence review process, which facilitate the implementation of resuscitation interventions proven to improve patient outcomes.

[h1] Introduction

Survival to hospital discharge rates following out-of-hospital cardiac arrest (OHCA) are increasing but remain in the range of 8–10% in many parts of the world. Higher survival rates are achieved in some centres that have optimised their local chain of survival. Strategies to increase rates of bystander CPR, increase the availability of public access automated defibrillators (AEDs), and to implement regional cardiac arrest networks will require collaboration with, and the engagement of, stakeholders. This review describes the epidemiology of OHCA, disparities in organisation and outcome, recent advances in treatment and ongoing controversies. We outline the standard of care that should be provided by the critical care specialist and propose future directions for cardiac arrest research.

[h1] Cardiac arrest: epidemiology and general trends

Incidence and survival from OHCA varies considerably both between countries and within countries. The EuReCa ONE study of 10,672 OHCA in 27 European countries during October 2014 reported an incidence of emergency medical services (EMS)-treated OHCA of 19.0 to 104.0 per 100,000 people per year, and an overall survival to hospital discharge of 10.3% [1]. The North American Resuscitation Outcomes Consortium (ROC) reported an incidence of EMS-treated OHCA of 73.0 (95% CI 71.2 to 74.7) per 100,000 adults per year in 2014/15 with an overall survival to hospital discharge of 11.4% (95% CI 10.4 to 12.4%) [2]. EMS-treated cardiac arrests account for about half of the OHCA attended by and assessed by EMS at ROC sites [3]. The

US Cardiac Arrest Registry to Enhance Survival (CARES) database of 132 U.S. counties reported widely variable survival to hospital discharge rates of 3.4 to 22.0% [4]. Some of these differences can be attributed to differences in healthcare systems, the quality of the local chain of survival, patient factors, and differences in how OHCA data is collected and reported. The recognition that there is potential to save many more lives from cardiac arrest has led to national strategies in some countries to improve outcome from OHCA [5, 6].

Studies suggest care and outcomes after OHCA are improving. In Denmark, the incidence of EMS-treated OHCA from a primary cardiac cause decreased from 40 to 34 per 100,000 people, and 30-day survival increased from 3.5 to 10.8% between 2001 and 2010 [7]. This improvement was associated with an increase in bystander CPR rates. Between 2001 and 2012 the Danish rate of bystander CPR among 30-day survivors increased from 66.6% to 80.6% ($P < 0.0001$), and the rate of bystander defibrillation among 30-day survivors increased from 2.1% to 16.8% ($P < 0.0001$) [8]. The North American ROC reported that between 2006 and 2010, survival to discharge after OHCA increased from 8.2% to 10.4% [3]. The best outcomes occur in patients with a witnessed primary cardiac arrest and an initial shockable rhythm (ventricular fibrillation/pulseless ventricular tachycardia– VF/pVT). Recent London Ambulance Service data show survival to hospital discharge for these patients has increased from 5% in 2001/2, to 12% in 2007/8, and to 31.5% in 2015/16 [9].

After return of spontaneous circulation (ROSC), most OHCA survivors are comatose or have another indication for tracheal intubation and mechanical ventilation [10, 11]. Retrospective UK data from the Intensive Care National Audit and Research Centre (ICNARC) between 2004 and 2014 showed that survivors of OHCA ($n = 29,621$) accounted for an increasing proportion of all mechanically ventilated admissions to ICUs (3.5 % in 2004, 5.8 % in 2014) [12]. Risk-adjusted hospital mortality following admission to ICU after in-hospital cardiac arrest (IHCA) and OHCA combined decreased significantly during this period (OR 0.96 per year). An Australian study of 3449 OHCA survivors between 2000 and 2014 reported a mean survival of 11.9 years, and a one-, 10-, and 15-year survival of 92.2%, 70.1% and 62.3% respectively [13]. After 5 years the standardised mortality rate for survivors was similar to the general population.

The quality of survival after cardiac arrest is most commonly assessed using the Cerebral Performance Category (CPC) or Modified Rankin Scale (mRS) with a CPC of 1–2 or a mRS of 0–3 considered a good neurological outcome. CARES data for 2015 showed that 81% of those surviving to hospital discharge had a CPC score of 1 or 2 [2]. Although most survivors have a good CPC or mRS outcome, these scales do not identify more subtle impairments in cognitive function or impairments in functional outcomes.

Importantly, CPC and mRS improve in survivors over time. In Denmark, 610 (76.6%) of the 796 cardiac arrest survivors between 2001 and 2011, who had been employed before their cardiac arrest returned to work in a median time of 4 months [14]. The proportion of survivors returning to work increased over time, from 66.1% in 2001–2005 to 78.1% in 2006–2011 ($P = 0.002$). When 287 survivors of OHCA from the TTM study were compared with 119 matched control patients with ST-segment-elevation myocardial infarction (STEMI) without OHCA at 180 days, attention/mental speed was more affected among cardiac arrest patients, but memory and executive functioning were similar [15]. The OHCA survivors also reported a more restricted societal participation and a lower return to work [16]. The Parisian registry compared health-related quality of life (HRQOL) data at a median of 50 months in 255 OHCA survivors with the general population using the Short Form 36 (SF-36) questionnaire [17]. In CPC 1 patients HRQOL was similar to age and gender matched controls in the general population whereas those with worse neurological outcomes (CPC 2 or 3) also had a worse HRQOL across most SF-36 dimensions.

[h1] Disparities in organisation and outcome

[h2] Variations in community response

Although several studies show a marked variation in OHCA survival across countries and regions, factors underlying this outcome variation remain incompletely explained [1, 4, 18, 19]. These geographical disparities in outcome may be associated with factors affecting each link in the chain of survival. A substantial proportion of the variation across countries seems to reflect differences in bystander response across communities (Table 1). Social economic and education disparities could explain some of this variation. In Australia, significant heterogeneity in rates of

bystander-CPR and survival have been documented across rural and metropolitan regions [20]. Neighbourhood characteristics may influence rates of bystander-initiated CPR. A large US cohort study (n=14 225) showed that patients who had an OHCA in low-income black neighbourhoods were less likely to receive bystander-initiated CPR than those in high-income white neighbourhoods [21]. This was confirmed in a recent study which documented that the lowest rates of bystander CPR and AED use occurred in predominantly black neighbourhoods and that these neighbourhoods had significantly lower likelihood for OHCA survival compared with predominantly white neighbourhoods [22]. Improving bystander interventions in these neighbourhoods may improve cardiac arrest survival. In a cross-sectional telephone survey, lesser education and lower income were associated with reduced likelihood of CPR training, illustrating the need to develop tailored CPR education to address this variability [23]. Language barriers for comprehension and implementation of telephone-CPR were also identified. In a recent US study that focused on Spanish-speaking callers, the average time for the dispatcher to recognize need for CPR was two-times longer than with English-speaking callers, and it resulted in longer delays to first compression [24].

[Insert table 1 near here]

[h2] Variations in emergency medical services systems

There are marked differences in the organisation of EMS, but it is unclear if this contributes to disparities in OHCA outcome. Ambulance crews using advanced life support (ALS) are staffed and equipped to provide sophisticated care on site, whereas basic life support (BLS) gives priority to rapid transport with only minimal treatment at the scene. The ALS crews can provide more sophisticated interventions, such as tracheal intubation for airway management and intravenous catheters for drug and fluid delivery, but they spend more time at the scene on average and their cost is higher. In a multicentre, controlled clinical trial conducted in 17 Canadian cities and enrolling 5638 OHCA patients, the implementation of ALS interventions did not improve the rate of survival [25]. More recently, several studies have questioned the usefulness of ALS interventions in OHCA, including airway management [26, 27], adrenaline (epinephrine) [28, 29], or anti-arrhythmic drugs [30]. In many parts of the world, ALS ambulances are also staffed with a physician

specialist in emergency medicine. One study that used propensity analysis documented that the presence of a physician on the ambulance was associated with better short and long-term outcome after OHCA [31] but other studies have failed to show benefit for prehospital physicians [32]. The findings of a recent systematic review were consistent with this benefit and suggested that physician-guided resuscitation may improve survival outcomes after OHCA [33] but the cost-effectiveness of this policy is controversial.

[h2] Regionalisation of cardiac arrest care

The wide disparities in outcome across institutions receiving OHCA patients led the American Heart Association (AHA) to recommend in 2010 the implementation of regional cardiac resuscitation centres for post-resuscitation care following OHCA [34]. This AHA policy stated that the essential elements of a 'Level 1' cardiac arrest centre should encompass an extensive experience with targeted temperature management (TTM), a 24 h/day capability for cardiac catheterisation laboratory, advanced haemodynamic support and treatment of re-arrest, the ability to perform electrophysiology testing and defibrillator assessment and placement, processes to ensure appropriate timing and methods of neurological prognostication, and finally a comprehensive multidisciplinary performance improvement program to continuously track outcomes [34]. In Arizona, implementation of a system of cardiac arrest centres (bypassing smaller hospitals) was independently associated with increased overall survival and favourable neurological outcome, particularly among patients with witnessed shockable rhythms [35]. Outside of US, the concept of cardiac arrest centres, although being informally accepted, is not firmly established and implemented. In the UK, for example, only 13% of acute hospitals could meet these requirements [36].

Considering the uncertainty about disparities in outcome, there is an urgent need for establishing national and international comparisons focusing in particular on public education, EMS organisation and cardiac arrest pathways. This may come from large registries that should be supported by health authorities.

[h1] Recent advances and ongoing controversies in cardiopulmonary resuscitation

[h2] Recent advances in the community response

Bystander CPR increases 30-day survival from OHCA by 2–3 times [37, 38]. Many EMS systems around the world have implemented telephone CPR systems whereby the dispatcher guides the bystander to provide chest compressions while awaiting arrival of EMS personnel. These telephone systems can significantly increase bystander CPR rates, survival to hospital discharge and survival with good neurological outcome [39-41]. Use of smart phones, which are generally equipped with Global Positioning System (GPS) technology, enables trained volunteers within 500–1000 m of a cardiac arrest to be dispatched by short message system (SMS) messages (Figure 2). In a randomised controlled trial involving 667 OHCA's such a system increased the rate of bystander CPR from 48% to 62% ($p < 0.001$) [42]. Since use of public access AEDs improve outcome [43], such GPS systems can also be used to guide volunteer responders to retrieve a nearby AED. This enables even faster defibrillation [44], but is dependent on the location of public access AEDs being registered with the local EMS. Unfortunately, the location of such AEDs is often unknown to the EMS, and this must be updated in the future. Finally, the use of drones to deliver AEDs to the scene of a cardiac arrest has been evaluated and has been shown to be feasible [45].

INSERT Figure 1 near here

The impact on outcome of ALS interventions remains unclear for both OHCA and IHCA. The optimal airway management technique is likely to vary during the resuscitation attempt and will depend on the skills of the rescuers and practice/logistics within each system. A randomised clinical trial of tracheal intubation versus bag-mask ventilation in OHCA (with intubation delayed until after ROSC) undertaken by prehospital physicians in France and Belgium showed no difference in favourable neurological outcome at 28 days [26]. Two recently completed but unpublished cluster randomised trials of a supraglottic airway (SGA) versus tracheal intubation will provide further data on airway management in OHCA [46, 47].

In a randomised trial in 851 OHCA patients, use of intravenous drugs following the existing guidelines compared with no use of drugs had no significant effect on long term outcome [48]. The impact of adrenaline on long-term outcome after cardiac

arrest has never been evaluated in an appropriately powered randomised controlled trial. A single under-powered randomised controlled trial and 14 observational studies which compared adrenaline (1 mg every 3–5 minutes) with no adrenaline indicate that the rate of ROSC is doubled (19.7% versus 5.5%; OR 2.85 (95% CI 2.28–3.54) but fewer patients survived with favourable neurological outcomes (1.9% versus 2.2%; OR 0.51 (95% CI 0.31–0.84) [49, 50]. An RCT comparing adrenaline with placebo in OHCA has just completed enrolment of over 8000 patients but has yet to be published [51].

Mechanical CPR devices enable high-quality CPR to be provided for prolonged periods and during transport. However, meta-analysis of five RCTs comparing mechanical CPR with manual CPR found no significant improvement in initial survival, survival to discharge / 30 days (odds ratio (OR) 0.89, (95% confidence interval (CI) 0.77- 1.02)) or favourable neurological outcome (OR 0.76, (95% CI 0.53, 1.11)) [52]. Despite these neutral studies, the use of mechanical CPR devices is still recommended for prolonged CPR, during transport to more advanced in-hospital treatment (e.g., extracorporeal-CPR (E-CPR)) or during interventions in the cardiac catheterisation laboratory [53].

Extracorporeal CPR in the form of veno-arterial extracorporeal membrane oxygenation (VA-ECMO) is being implemented in many healthcare systems. A systematic review and meta-analysis of observational data documented an association between use of E-CPR and an increase in survival and favourable neurological outcome [54]. There are significant challenges posed in implementing E-CPR, not least cost and local expertise in the technique. Outcomes are likely to be optimised by adhering strictly to evidence-based inclusion and exclusion criteria [55, 56].

[h1] Post-resuscitation care: current practice and ongoing controversies

[h2] Coronary angiography

In patients resuscitated from OHCA without an obvious non-cardiac cause the prevalence of an acute coronary artery lesion ranges from 59 to 71% [57].

Observational evidence shows that in resuscitated OHCA of suspected cardiac origin with ST segment elevation (STE) or left bundle branch block on post-ROSC

electrocardiogram (ECG) emergent coronary angiography and PCI when appropriate are associated with increased survival and favourable neurological outcome, and it is currently recommended [57]. In patients without STE on the post-ROSC ECG the potential benefits of early invasive management are currently under investigation in several randomised trials (NCT02309151, NCT02387398, NCT02750462). In patients with refractory OHCA from VF/pVT and admitted to hospital with ongoing CPR, an early invasive management bundled with E-CPR resulted in 42% rate of survival to discharge with good neurological outcome [58].

[h2] Targeted temperature management

Fever is common after CA and it is mainly related to an inflammatory response during the reperfusion phase. Targeted temperature management (TTM) at 33–36 °C is a key element of post-resuscitation care and it can be achieved using both invasive and non-invasive techniques [59]. There is inconclusive evidence whether any temperature target is better than the other and there is variation in practice throughout Europe [60] as well as North America. If the target is 36°C, efforts should be made to stay within target and avoiding higher temperatures [61]. The recommended duration of TTM should be at least 24 hours [62]. In unconscious survivors of OHCA, TTM at 33°C for 48 hours did not significantly improve 6-month neurological outcome compared with TTM for 24 hours [62]; however, survival was very high in both groups. The phase 3 TTM-2 trial has just started recruiting and is comparing comatose post OHCA patients treated with TTM at 33°C versus standard care avoiding fever ($\leq 37.8^{\circ}\text{C}$) (NCT02908308). Cardiac arrest patients are complex and heterogeneous, and it is likely that the optimal treatment strategy will depend on the cause of cardiac arrest, the severity of the reperfusion injury and the haemodynamic status of each patient. The evidence for the use of TTM after IHCA is inconclusive, and intensivists should use clinical judgement when applying TTM for IHCA patients [63].

[h2] Oxygenation targets

Observational evidence suggests that extreme hyperoxia ($\text{PaO}_2 > 300$ mmHg or 40 kPa) after CA may be harmful [64]. In an RCT involving patients with prehospital STEMI, but not cardiac arrest, routine oxygen therapy compared with oxygen only if $\text{SpO}_2 < 94\%$ resulted in significantly larger infarct size [65]. In another recent RCT of

more than 6000 patients with suspected acute myocardial infarction (AMI), oxygen 6 lpm for 6–12 h compared with air did not reduce death at 365 days, the primary endpoint [66]. A Phase 3 study (EXACT) involving titration of oxygen to a target SpO₂ 90–94% as soon as possible after ROSC in OHCA has just started recruiting (NCT02499042). Pending the results of this trial, the inspired fraction of oxygen after ROSC should be titrated to maintain the arterial blood oxygen saturation in the range of 94–98 % [57].

[h2] Post-resuscitation ventilation

Hypercapnia is common immediately after ROSC, while iatrogenic hypocapnia due to hyperventilation may occur especially during TTM and worsen cerebral ischaemia [67]. Hypercapnia might increase blood flow to ischaemic brain and observational studies have documented an association between mild hypercapnia and better neurological outcome [68, 69] and better cerebral oxygenation [70] among post cardiac arrest patients. A phase 2 study comparing mild hypercapnia with normocapnia in 50 post arrest patients documented a lesser increase in neuron specific enolase (NSE) values in the hypercapnia group [71]. A Phase 3 study (TAME) of normocapnia versus mild hypercapnia (6.6–7.3 kPa (50–55 mmHg)) in post-cardiac arrest patients will soon start recruiting (NCT03114033). Current recommendations are that ventilation should be titrated to target normocapnia [57]. A protective lung ventilation (tidal volume 6–8 ml kg⁻¹ ideal body weight and positive end expiratory pressure 4–8 cm H₂O) is recommended and may be beneficial in OHCA patients [72].

[h2] Blood pressure targets

Intensivists often will control the blood pressure with vasoactive medicines, but the optimal target is not clear. Each individual probably has different minimum pressures for adequate perfusion of various organs based on their history of hypertension and current vascular tone. Cerebral autoregulation is disturbed in a third of comatose post-cardiac arrest patients [73] and optimal perfusion of the injured brain may require higher mean arterial pressures (perhaps 85–100 mmHg) than typically selected in non-brain injured patients (>65 mmHg) [74].

[h2] Prognostication

Two-thirds of deaths occurring in patients who are admitted comatose to ICU after ROSC follow withdrawal of life-sustaining treatment (WLST) because of presumed irreversible hypoxic-ischaemic brain injury (HIBI) [75]. Ensuring optimal prognostication is essential to avoid potential harm resulting from an inappropriate WLST. Before prognostic assessment is made, major confounders – such as residual sedation or neuromuscular blockade – should be excluded and, for this reason, using short-acting drugs is preferable [76]. In patients who are unconscious with absent or extensor motor response to pain at 72 hours or more after ROSC, a bilateral absence of N20 wave of somatosensory evoked potentials and/or bilateral absent pupillary response to light predicts severe neurological disability or death with <5% false positive rate and narrow confidence intervals [57]. When these signs are absent, a combination of two or more among early status myoclonus, high blood values of NSE, or signs of severe HIBI on brain computed tomography or EEG also suggests a poor neurological outcome, but the confidence in this prediction will be lower. If none of these conditions is present, the prognosis is indeterminate, and further observation is indicated. This can be prolonged, since delayed awakening is common in patients with an eventually good outcome after cardiac arrest [77].

Acquired brain injury patients who have early (first week) mobilisation and rehabilitative interventions show more improvement in functional measures than patients without early mobilisation [78].

Future directions

Priority areas for future research in cardiac arrest have been defined recently [79, 80]. Adequately-powered randomised trials are the gold standard for evidence of the efficacy and effectiveness as well as implementation of interventions in patients with acute cardiovascular conditions. Randomised controlled trials for efficacy are relatively rare in resuscitation science. Even so, when a treatment, an intervention or a system of care change is based on the highest level of evidence, adoption and widespread implementation takes time. Several factors reduce the rate of evidence-based change in clinical practice related to treatment of patients with OHCA. Some of these factors may be modifiable by clinicians, researchers and policy makers.

The first modifiable factor is the lack of resources dedicated to support high-quality randomised trials in resuscitation (Table 2). Resources for health care research are limited. Cardiac arrest research is underfunded compared to other clinical disorders [81]. The Resuscitation Outcomes Consortium (ROC) was a North American multi-center clinical research network designed to conduct clinical out-of-hospital trials of therapies for cardiac arrest and major trauma. Over a ten-year period, communities that participated in ROC observed a doubling of survival after OHCA [3, 82]. This suggests that outcomes after OHCA can be improved, and that further investments in research and implementation warrant consideration. Multinational collaborations will facilitate the rate of recruitment into randomised trials and is a strategy being increasingly adopted in resuscitation research.

Insert Table 2 near here

The second modifiable factor that would facilitate the implementation of randomised trials in resuscitation is global uniformity in the approach to enabling trials to use waiver of informed consent. Patients in cardiac arrest cannot provide individual consent before they are enrolled in a clinical trial. There is considerable variation in policies and procedures related to exemption from informed consent for emergency research [83, 84]. In some settings, waiver of consent is not permitted, and the investigator must seek, deferred consent or consent may be required for ongoing participation in a clinical trial. Either approach may introduce bias if those who consent have different baseline characteristics or outcome as compared to those who do not [85].

A third modifiable factor is the analytical approach for cardiac arrest trials. Overall, survival after OHCA with any initial rhythm is low. Traditionally randomised resuscitation trials use fixed sample size to compare the effect of one or more interventions compared to standard care. Ordinarily such trials use logistic regression to evaluate survival to discharge or good neurologic status at discharge. Fixed or group sequential methods may require many subjects to detect a clinically important difference in such binary outcomes because of the low overall rate of success after resuscitation. As a consequence, some recent randomised trials have

sought to enroll several thousand subjects or more over several years to detect the minimum clinically important difference in survival [51, 86]. There is a need to accelerate the processes and efficiency of future trials. Adaptive trial designs which use accumulating data to inform changes to the study as it progresses may accelerate generation of knowledge and reduce cost [87]. However, this may be at the expense of the reliability of the treatment estimates derived from the trial [88]. Bayesian approaches which make use of prior information can be used to provide a quantitative summary of treatment effect when traditional approaches for defining statistical significance are impractical [89]. Registry-based trials and trials which obtain follow-up data through administrative data sources may reduce the burden and cost of data collection [90, 91]. These are very challenging to do well and meet the privacy and ethical concerns which appear to evolve often across legislations [92].

The fourth modifiable approach to randomised cardiac arrest trials is the definition of the primary outcome of interest. Traditionally most trials have measured survival to hospital discharge as this measure is convenient, least costly and unbiased. Neurological favourable outcome at discharge or 30 days is also a useful measure and is collected in many OHCA trials. The use of hospital-free survival, assessed as the number of days alive and out of hospital during the first thirty days post arrest may provide statistical efficiency over dichotomous outcomes such as survival and favourable neurological outcome [93]. Although this is measurable and may reduce sample size requirements in costly randomised trials, like progression-free survival in cancer, there is controversy about the usefulness of this measure in cardiac arrest trials [94, 95].

Outcomes preferred by investigators may not be what is important to patients. Trials involving critically ill patients rarely measure patient reported outcomes as the primary or secondary outcome measure (5% vs 22% respectively) [96]. Patients and their family members involved in the Core Outcomes Set for Cardiac Arrest (COSCA) process identified survival, neurological function and health-related quality of life as the preferred outcome measure [97]. To date, studies of post-discharge outcomes have provided conflicting evidence of the magnitude of impairment after cardiac arrest [15, 86, 98, 99]. These discordant results may partly reflect difference in the

timing and method of measurement. Proximate assessments are easier to obtain but may not fully reflect patient recovery; downstream assessments may more fully reflect recovery but are harder to obtain, add significantly to the cost of the trial and delay study completion.

The final modifiable factor is the need to have a translation or implementation component to each randomised trial. Many granting agencies include a knowledge translation requirement for all grants hoping to move the responsibility for scientific advancements from bench to bedside into the hands of the investigator. This intervention alone has not had an impact and there are large delays in implementation. The emphasis appears to be shifting to those responsible for publishing guidelines and making policy [100]. The International Liaison Committee on Resuscitation (ILCOR) is moving to a continuous evidence review process where systematic reviews of high priority research questions are posted and council guidelines will change accordingly (www.ilcor.org) [101]. This may not be enough for policy to change. Scaling up and spread of effective health interventions may require a more novel approach of partnerships [102]. We anticipate that partnerships between ILCOR, the World Health Organization and the Global Resuscitation Alliance, for example, might generate the impetus for change.

[h1] Legends

Figure 1. A text message (TM) alert system in North Holland. When a dispatcher suspects an out-of-hospital cardiac arrest, trained first responders within 1000 m are alerted to either first retrieve an automated external defibrillator (if within 500 m) and then go to the victim or to go directly to the victim and start CPR [44]. Reproduced with permission from Resuscitation.

[h1] Conflict of interest statement

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[h1] References

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