Changes in ventricular fibrillation quantitative waveform measures in out-of-hospital cardiac arrest in relation to acute myocardial infarction

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Introduction: Quantitative waveform measures (QWM) of ventricular fibrillation (VF) can predict outcome from out-of-hospital cardiac arrest (OHCA). Previous studies showed that ischemic heart disease might lower QWM, thereby possibly altering their predictive capacity. We assessed the hypothesis that the amplitude spectrum area (AMSA) of VF is lower in the setting of ST-elevated acute myocardial infarction (AMI).

Methods: Data from the ARREST-study, an OHCA registry in North-Holland, the Netherlands, were used. AMSA was calculated for the first artefact-free VF segment (sample frequency 125 Hz). Etiology of OHCA (AMI/non-AMI) was assessed by review of hospital charts. Mann–Whitney U test and multivariate linear regression with log-transformed AMSA were used to assess the association between AMSA and AMI, in relation to call-to-ECG delay, while correcting for resuscitation characteristics.

Results: We included 716 VF inpatients between 2005 and 2012 with available ECG (LifePak AED or manual defibrillator). AMI was diagnosed in 328 patients (46%). AMI patients were younger (61.4 vs. 66.8 years, P<0.001), collapsed more often at home (62% vs. 54%, P=0.04), had more often an EMS-witnessed collapse (23% vs. 5.3%, P<0.001) and shorter call-to-ECG delay (7.1 vs. 7.8 min) compared to non-AMI patients. Median AMSA for AMI patients (8.4 mV Hz [IQR 3.7–16.5]) was significantly lower compared to patients without AMI (12.3 mV Hz [IQR 5.6–23.0]), also when corrected for the resuscitation characteristics (P<0.001). Fig. 1 shows that, regardless of call-to-ECG delay, AMSA of AMI patients is lower.

Conclusion: OHCA patients with VF and acute MI have a lower AMSA. When using QWM as a predictor of survival in OHCA, it is important to note that VF is affected by AMI.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.009
**BoB2**

**Asystole, but not severe bradycardia, is an electrocardiographic rhythm of poor long-term outcome in cardiac arrest in children**


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**Purpose of the study:** To study the association between the first rhythm in paediatric cardiac arrest (CA) and bad outcome at 6 months in patients a) admitted to Emergency Departments (ED) with Out-of-Hospital cardiac arrest (OHCA) or b) Emergency-Department cardiac arrest (EDCA).

**Materials and methods:** Prospective study (65 hospitals, 6 countries) using Utstein style with paediatric Out-of-Hospital CA (OHCA) and Emergency-Department CA (EDCA) in patients admitted to ED. We followed the patients for 6 months after CA and, in case of survival, the Paediatric Overall Performance Category (POPC). A POPC of 3–6 was considered a bad overall outcome. Data collection was done from 1 June 2014 to 31 March 2016.

**Results:** We analysed 101 CA, 14.9% of which were EDCA. Median age was 3.6 years (range 0–17.2), 62.4% male. The initial rhythm was asystole in 51.4% of CA, bradycardia 22.8%, ventricular fibrillation 6%, pulseless electrical activity 4%, pulseless ventricular tachycardia 3%, unknown rhythm 12.8%. Thirty-eight children survived to hospital discharge: 15 with POPC 1, 7 with POPC 2, 10 with POPC 3, 4 with POPC 4 and 2 with POPC 5.

We knew the first rhythm in 89 patients, of whom 88 were followed for 6 months after the CA. Asystole was associated with no survival to 6 months (RR 2.1, 95% CI 1.4–3.2) and with bad overall outcome (RR 1.7, 95% CI 1.2–2.3) at 6 months. Nevertheless, 7 patients whose first rhythm was asystole survived and 3 had POPC 1 or 2 at that time. Severe bradycardia was not significantly associated with a worse outcome at 6 months; 13/23 children with bradycardia survived at 6 months, 9 of whom had POPC 1 or 2.

**Conclusions:** Children admitted to ED with asystole as first rhythm of CA have a lower survival and overall outcome at 6 months than other groups such as bradycardia.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.010

**BoB3**

**Prediction of survival and overall outcome in paediatric cardiac arrest: Blood parameters or PELOD score?**


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**Purpose of the study:** To study the association between selected blood parameters and a score of organ dysfunction with better outcome in patients (a) admitted to Emergency Departments (ED) with out-of-hospital cardiac arrest (OHCA) or (b) Emergency-Department cardiac arrest (EDCA).

**Materials and methods:** Prospective study (65 hospitals, 6 countries) using Utstein style in patients admitted to ED with OHCA or EDCA. We measured the first pH and lactate after cardiac arrest (CA) as well as Paediatric Logistic Organ Dysfunction score (PELOD) in the first 24 h. We followed the patients until discharge and, in case of survival, the Paediatric Overall Performance Category (POPC). A POPC of 1 or 2 was considered a good overall outcome. Data collection from 1st June 2014 to 31st March 2016.

**Results:** We have analysed 101 CA, 14.9% of which were EDCA. Median age was 3.6 years (range 0–17.2), 62.4% male. First blood pH: mean 7.00, SD 0.26, range 6.38–7.45. First lactate: median 8, range 0.17–23 mmol/l. PELOD24 h: mean 26.1, SD 17.8, range 0–72.

Thirty-eight children survived to hospital discharge: 15 with POPC 1, 7 with POPC 2, 10 with POPC 3, 4 with POPC 4 and 2 with POPC 5; 6 children either remain inpatients or are missed patients.

14 Pediatric Cardiac Arrest Study Group, Spain
15 Pediatric Cardiac Arrest Study Group, Spain
We found an association between survival to discharge and (a) higher blood pH (<0.001), (b) lower lactate \( (p = 0.003) \) and (c) lower PELOD24 h (0.003).

We found an association between survival to discharge with POPC 1 or 2 and (a) higher blood pH \( (p = 0.007) \) and (b) lower PELOD24 h \( (p < 0.001) \). Lower lactate did not reach significant difference.

**Conclusions:** Blood pH, blood lactate and PELOD24 h are good predictors of survival to hospital discharge in children after OHCA and EDCA. Nevertheless, only blood pH and PELOD24 h seem to be adequate predictors of a good overall outcome to discharge.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.011
AS01

Effects of dispatcher-assisted cardiopulmonary resuscitation on survival outcomes by age group in pediatric out-of-hospital cardiac arrests

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Objective: We studied the effect of a dispatcher-assisted cardiopulmonary resuscitation (DA-CPR) program on pediatric out-of-hospital cardiac arrest (OHCA) outcomes by age groups.

Methods: All emergency medical services (EMS)-treated pediatric OHCAs in Korea were enrolled between 2012 and 2014, excluding cases witnessed by EMS providers and those with unknown outcomes. Exposure was bystander CPR (BCPR): BCPR-with-dispatcher assistance (DA), BCPR-without-DA and No-BCPR. Endpoint was survival to discharge. Multivariable logistic regression analysis was performed. The final model with an interaction term was evaluated to compare the effects across age groups.

Results: In total, 1529 patients (32.8% BCPR-with-DA, 17.3% BCPR-without-DA, and 54.6% No-BCPR) were included in the final analysis. BCPR-with-DA and BCPR-without-DA in the groups by age were 43.2% and 15.5% in 0–12 months, 33.1% and 21.8% in 1–8 years, and 25.7% and 16.0% in 9–18 years, respectively. Both BCPR-with-DA and BCPR-without-DA were more likely to have higher survival to discharge (8.8% and 12.1%) compared with No-BCPR (3.9%). The adjusted ORs (95% CIs) for survival to discharge were 1.77 (1.04–3.00) in BCPR-with-DA and 2.86 (1.61–5.08) in BCPR-without-DA compared with No-BCPR (3.9%). The adjusted ORs (95% CIs) for survival to discharge were 2.18 (1.07–4.42) and 2.27 (1.01–5.14) for 9–18 years; 2.32 (0.64–8.44) and 6.21 (1.83–21.01) for 1–8 years; and 1.06 (0.41–2.77) and 2.00 (0.64–6.18) for 0–12 months, respectively.

Conclusions: BCPR, regardless of DA, was associated with improved survival outcomes after OHCA in pediatrics. However, the associations between DA-BCPR and survival outcomes were different by age groups.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.013

AS02

A novel algorithm can make accurate shock/no-shock decisions during ongoing chest compressions with non-EMS first responders

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Background: Interruptions in chest compressions (CCs) are associated with lower chances of survival and are common among non-emergency medical services (non-EMS) first responders. Conventional automated external defibrillators (AEDs) require these interruptions to determine if a patient needs a defibrillation shock, but a novel algorithm (cprINSIGHT™ Analysis Technology) can make this determination during ongoing CCs, according to data from cardiac arrests treated by professional responders. The purpose of this study was to analyse the performance of cprINSIGHT on data from cardiac arrests treated by non-EMS first responders.

Methods: Data from 289 patients with cardiac arrest yielded 697 eligible 30-s segments of ECG and impedance data that included compression artefact. To create a gold standard, each segment was over-read by two experts who decided whether the rhythm was shockable or non-shockable. cprINSIGHT was run on these segments; for each segment, it decided “shock” or “no shock”, or required the user to pause CCs for further analysis. In this context, sensitivity and specificity are the percentage of expert-labelled shockable segments that cprINSIGHT advised to shock and expert-labelled non-shockable segments it advised not to shock, respectively.

Results: The data set included 104 expert-labelled shockable segments and 593 expert-labelled non-shockable segments. For the remaining 14.5%, the algorithm required a pause in CCs for further analysis.

Conclusions: CPR, regardless of DA, was associated with improved survival outcomes after OHCA in pediatrics. However, the associations between DA-BCPR and survival outcomes were different by age groups.
Conclusions: The high performance of this algorithm indicates that interruptions in CCs to analyse the ECG can be greatly reduced without sacrificing decision accuracy. This may lead to improved survival in a particularly viable group of patients treated by non-EMS first responders.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.014

AS03

Effect of cardiopulmonary resuscitation on myocardial ATP for successful defibrillation in an animal model of ventricular fibrillation

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Purpose: No research has been conducted on the association between myocardial ATP maintained by chest compression and the success of defibrillation during cardiac arrest from ventricular fibrillation (VF). The aim of this study was to investigate the effect of cardiopulmonary resuscitation (CPR) on myocardial ATP and the relationship between myocardial ATP level and defibrillation success.

Materials and methods: Thirty-two dogs were included in this study. After induction of ventricular fibrillation (VF), animals were randomized into two groups. The no-CPR group (n = 16) did not receive CPR, whereas the CPR group (n = 16) received conventional CPR after 4 min of VF. Samples for myocardial ATP measurement were obtained from the endocardial surface of the left ventricle by using myocardial biopsy forceps. Myocardial ATP and hemodynamic parameters were measured and defibrillation was attempted by using myocardial biopsy forceps. Myocardial ATP and hemodynamic parameters were measured and defibrillation was attempted 8, 12 and 16 min after VF induction.

Results: Rate of successful defibrillation was higher at 8 and 12 min after VF induction in CPR group than in no-CPR group (at 8 min: 53 vs. 35, p = 0.001; at 12 min: 44 vs. 29, p = 0.000; at 16 min: 33 vs. 27, p = 0.076). Myocardial ATP levels were decreased over time during resuscitation, and were higher in the CPR group than in the no-CPR group at 8 and 12 min after VF induction (at 8 min: 2.23 ± 0.31 vs. 1.68 ± 0.43 10−9 mol/mg, p = 0.004; at 12 min: 1.78 ± 0.16 vs. 1.23 ± 0.09 10−9 mol/mg, p = 0.000; at 16 min: 1.25 ± 0.12 vs. 1.17 ± 0.14 10−9 mol/mg, p = 0.054).

Conclusion: In animal models with ventricular fibrillation, myocardial ATP levels are higher in the CPR group than in the no-CPR group during the first 8 min after resuscitation. Decrease in the rate of ATP decay by CPR during early phase of cardiac arrest is associated with successful defibrillation.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.015

AS04

Cardiac arrest and CPR knowledge in last year medical students: A skill to be improved in Italy

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Purpose: The aim of our study was to assess the current situation about CPR/AED knowledge of last-year medical students in Italy.

Methods: An anonymous online survey comprising 29 questions, realised by non-profit organisation “Pavia nel Cuore”, was provided to all Italian last-year medical students throughout the Italian Medical Students’ Secretariat (SISM).

Results: A total of 488 medical students, who were attending the last 2 months of their studies, from 32 different universities, filled the survey. Only 25% declared inability to help a victim of sudden cardiac arrest (SCA) and only 77% attended a CPR/AED training. This training was organised by medical schools in 73% of cases and 57% of those interviewed judged this course inadequate; 42% of students attended a CPR/AED training at the University organised mostly by non-profit organisations (76%).

The second part of the survey was focused on CPR knowledge: 93% of students know that the leading cause of SCA is an acute myocardial infarction, but only 33% is aware of the incidence of SCA; 48% of participants know that irreversible brain damage starts 5 min after SCA and 24% thinks it starts after 10 min. The appropriate compression depth (5–6 cm) is correctly known only by 330 students (68%), whilst the right compression rate (100–120/min) only by 53%. However, the correct compression:ventilation ratio is well known by medical students (89%). It is interesting to notice that 66% of participants think that is necessary to perform the Heimlich manoeuvre or 5 back blows during mild foreign-body airway obstruction (patients who can cough and speak).

Conclusions: Data collected suggest that knowledge on CPR is quite poor in medical students at the end of their studies. We think it is necessary to introduce a mandatory CPR/AED course in every medical school to improve this knowledge.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.016

AS05

Is CPR feedback effective in educating minimally trained users to deliver optimal chest compression rate?

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Introduction: Real-time cardiopulmonary resuscitation (CPR) feedback mechanisms are becoming more prevalent in public access defibrillators (PAD). This feedback is important in educating users to deliver of optimal chest compressions. Studies have
shown that chest compression rates above 120 compressions per minute (CPM) are associated with declining ROSC, decreased blood flow, and lower survival rates. A usability study was conducted to assess if a PAD incorporated with audio–visual CPR rate feedback assisted minimally trained users in achieving guideline CPR rates.

Methods: Randomly selected minimally trained users were recruited in a shopping mall (n = 156; 15–65+ years) to use a PAD incorporated with CPR rate feedback in a simulated scenario. Compressions were captured by measuring displacement of a potentiometer in a custom manikin. Audio feedback instructed the user to “Push Faster” or “Push Slower”, or to state that compressions were performed at “Good Speed”. A visual interface with a sequence of light emitting diodes also indicated the users compression rates (Table 1).

Results: A total of 136 (87.2%) participants achieved CPR rate at a “Good Speed” within 45 s of beginning CPR. Of these 136 participants, 14 participants did not maintain compressions at this rate. Twenty participants did not achieve the target compression rate within 45 s; however, 8 of these participants achieved “Good Speed” within 1 min. The median time to reach “Good Speed” was 27 s for all participants.

Conclusion: An audio–visual machine interface with CPR rate feedback is a successful tool in educating users to deliver optimal chest compression rate.

Reference

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http://dx.doi.org/10.1016/j.resuscitation.2016.07.017

Table 1

<table>
<thead>
<tr>
<th>CPR speed</th>
<th>Corresponding voice prompt</th>
<th>LED lights displayed</th>
<th>Corresponding CPR chest compression rate (CPM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Too slow</td>
<td>“Push Faster”</td>
<td>&lt;90</td>
<td>90–100</td>
</tr>
<tr>
<td>Good com-</td>
<td></td>
<td>100–120</td>
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<tr>
<td>pres-</td>
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<tr>
<td>Too fast</td>
<td>“Push Slower”</td>
<td>120–130</td>
<td>&gt;130</td>
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Influence of ventilation patterns of mechanical ventilation on manual chest compressions during cardiopulmonary resuscitation in a simulation model

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Purpose of the study: Numerous studies have addressed quality of chest compressions during resuscitation as this mainly determines survival from cardiac arrest. Nevertheless, little is known about the influence of mechanical ventilation. We investigated the effects of mechanical ventilation with intermittent positive pressure ventilation (IPPV), bilevel positive airway pressure (BiLevel)
and the novel ventilation mode chest compression synchronised ventilation (CCSV) to depth and compression rate of manual chest compression in a simulation model.

**Materials and methods:** Informed consent and ethics committee approval were obtained. Ninety paramedics were enrolled and delivered uninterupted, manual chest compressions over 2 min in an ALS-simulator with realistic lung model. The ALS-simulator was ventilated with IPPV, BiLevel and CCSV for 30 s each in randomised order. Depth and compression rates were measured and compared with ILCOR-Guidelines (depth > 50 mm, compression rate = 100–120/min). Values as median (25/75% percentiles). Relative frequencies (RF) were tested for significance using chi-squared (c) and Friedman (F) tests.

**Results:** Depth (mm): IPPV 56(48/63), BiLevel 57(48/63), CCSV 60(52/67); RF (match) IPPV 1.0 (0.23/1.0) vs. CCSV 1.0 (0.9/1.0), p < 0.0001 (c), p = 0.0036 (F); BiLevel 1.0 (0.28/1.0) vs. IPPV, p = 0.59 (c), p = 0.73 (F) and BiLevel vs. CCSV p < 0.0001 (c), p < 0.001 (F).

Compression rates (1/min): IPPV 117(105/124), BiLevel 116(107/123), CCSV 117(107/125), RF (match) IPPV 0.5 vs. BiLevel 0.49, p = 1.0 (F) and vs. CCSV 0.47, p = 1.0 (F). BiLevel vs. CCSV p = 1.0 (F).

**Conclusions:** In this simulation model, manual chest compression rates were equal during ventilation with IPPV, BiLevel and CCSV. Ventilation with CCSV led to better compression depth compared to IPPV and BiLevel ventilation.

**References**


http://dx.doi.org/10.1016/j.resuscitation.2016.07.019

**AS09**

**Post-shock and post-analysis pauses: From theory to practice AED data from the Pavia CARE and TiReCa**

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**Purpose:** It has been well documented how post-shock pauses longer than 5 s negatively affect survival of patients in cardiac arrest. The current guidelines indeed recommend to resume immediately chest compressions after the shock if needed or, otherwise, at the end of the analysis. However many automated external defibrillators (AED) show a not recommended latency longer than 6 s before instructing to resume CPR. The aim of our study was to assess whether this latency was present in real practice both among lay people and in EMS rescuers using an AED.

**Methods:** We analysed available AED reports of cardiac arrests included in the registries of the Province of Pavia (Pavia CARE) and of the Ticino Region (TiReCa) occurred between October 2014 and December 2015. We collected 105 AEDs used by EMS rescuers (413 pauses analysed, 3.9 pauses/AED) and 55 AEDs used by lay people (109 pauses analysed, 2 pauses/AED). We calculated the pauses through the massage artefacts.

**Results:** EMS rescuers were significantly faster than rescuers in resuming CPR both in the overall dataset [4.8 s (95% CI 4.6–5.1) vs. 7 s (95% CI 5.9–7.7), respectively, p < 0.0001] and when considering the shockable rhythms [2.7 s (95% CI 2.1–3.13) vs. 6 s (95% CI 4.2–8], p = 0.0001] and non-shockable ones [5 s (95% CI 4.8–5.5) vs. 7 s (95% CI 5.8–8), p < 0.0001]. Notably, only for EMS rescuers were the post-shock pauses significantly shorter for shockable rhythms [2.7 s (95% CI 2.1–3.13) vs. 5 s (95% CI 4.8–5.5), p < 0.0001].

**Conclusion:** Post-shock pauses are an underestimated, yet important issue that mostly affect cardiopulmonary resuscitation performed by lay rescuers. Training and technological efforts to reduce hand-off time are needed.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.020
Conclusions: For two-tiered EMS system, in situations where ALS team is dispatched first, two–team model of response may predict better survival for OHCA compared with a single ALS team only. On the contrary, in situations where a BLS team was dispatched first, the two–team model may have worse survival outcomes than a single BLS team response.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.021

AS10

An innovative media analysis technology for recognizing cardiac arrest of asystole and pulseless electrical activity

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Purpose: Poor recognition of cardiac arrest or agonizing situation may delay early bystander CPR that should be instantly provided in the first few minutes at scene. Less than half of the general public can correctly identify cardiac arrest by carotid pulse. Technology for better recognition of cardiac arrest at scene would facilitate early public CPR and defibrillation. In this study, we aim to innovate a video analysis tool to assist recognition of cardiac arrest.

Methods: We created an innovative skill algorithm for transforming and analysing signals of smartphone video taken for part of the human body. Fast Fourier Transform (FFT) signals were evaluated in a designed skill algorithm. Each video recording lasted 15 s, filmed within the first 5 min after cardiac arrest witnessed in the intensive care unit. We applied this skill algorithm analysis on smartphone videos of cardiac arrest including asystole and pulseless electrical activity (PEA) patients, and compared them with those of normal volunteers.

Results: Video segments from 30 cardiac arrest patients (asystole for 15, PEA for 15) and age- and sex-matched normal volunteers (median heart rate 75/min, IQR 66–89/min) were analysed. From the cluster of FFT signals evaluated (Fig. 1), we developed mathematical formulas to describe the characters of FFT signal distribution (two derived values called Slope Alfa and Slope Beta) for each video segment. The Slope Alfa and Beta values (Mean [SD]) of volunteers were significantly different from those of asystole (Slope Alfa 0.77 [0.20] vs. 0.11 [0.05] p < 0.01; Slope Beta 7.80 [6.46] vs. 0.43 [0.22] p < 0.01), as were those of PEA (Slope Alfa 0.16 [0.10] p < 0.01; Slope Beta 0.57 [0.33] p < 0.01). The results also indicated a tendency where, for cardiac arrest, both Slope Alfa and Beta would be less than 1.0.

Conclusions: This innovative skill algorithm for smartphone video analysis may successfully recognize patients of cardiac arrest. Further technology integration with mobile handheld devices would provide the general public an easily accessible tool for cardiac arrest recognition and early chest compressions.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.022

AS11

Availability and density of text-message alerted local rescuers and automated external defibrillators for early defibrillation in out-of-hospital cardiac arrest

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Background: To increase early defibrillation in out-of-hospital cardiac arrest (OHCA) in residential areas, a dispatcher-driven alert system that uses text messages to direct local rescuers with and without automated external defibrillators (AEDs) to OHCA patients was implemented. We evaluated whether activation of ≥1 rescuer decreased time to defibrillation and increased the proportion of bystander cardiopulmonary resuscitation (CPR). We also investigated the relationship between density of available AEDs and rescuers in the system and time to defibrillation.

Methods: The study was performed between February 2010 and August 2014 in two Dutch regions with 1.27 million inhabitants. In a database, the location of 1703 AEDs and home and/or work address of 16,545 rescuers were stored. When an OHCA was suspected, the dispatcher activated nearby rescuers with a text message. Two-thirds were directed to a nearby AED first and one-third directly to the patient.

Results: From all cases where the dispatcher activated the system, 437 patients collapsed in a residential area and had a shockable initial rhythm. In 59 cases, no rescuers were available for dispatch to an AED and in 378 cases ≥1 rescuer was directed to an AED. Time to defibrillation decreased from 10.7 to 8.6 min (P < 0.001) and proportion of bystander CPR increased from 81 to 93% (P < 0.001) if ≥1 rescuer was directed to an AED. We found a statistically significant relationship between higher AED and rescuer density and shorter time to defibrillation. The availability of two AEDs and 10–20 rescuers per km² did not result in further decrease of time to defibrillation.

Conclusion: A dispatcher-driven text-message alert system that directs rescuers via an AED to OHCA patients decreased time to...
defibrillation in patients in residential areas. The optimum density
of AEDs and rescuers appears to be when two AEDs and 10–20
rescuers per km² were available for dispatch.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.023

AS12

Implementation, temporal changes, and follow
up of a nationwide AED-network

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Purpose: To describe the temporal development of automated
external defibrillator (AED) deployment in Denmark according to
type of AED location and AED accessibility.

Materials and methods: We collected information on all AEDs
registered in the nationwide Danish AED network from 2007 to
2014, including type of AED location, AED accessibility 24 h a day
(24/7), and year of AED deployment.

Table 1

<table>
<thead>
<tr>
<th>Year of registration</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
<th>Total (n)</th>
</tr>
</thead>
<tbody>
<tr>
<td>All registered AEDs, n (%)</td>
<td>135 (1.1)</td>
<td>490 (4.1)</td>
<td>869 (7.2)</td>
<td>2142 (17.8)</td>
<td>1756 (14.6)</td>
<td>2145 (17.8)</td>
<td>2251 (18.7)</td>
<td>2257 (18.7)</td>
<td>12,045 (100.0)</td>
</tr>
<tr>
<td>Work (e.g. companies, offices), n (%)</td>
<td>19 (14.1)</td>
<td>113 (23.1)</td>
<td>230 (26.5)</td>
<td>659 (30.8)</td>
<td>532 (30.3)</td>
<td>662 (30.9)</td>
<td>606 (26.9)</td>
<td>640 (28.4)</td>
<td>3461 (28.7)</td>
</tr>
<tr>
<td>School education facility, n (%)</td>
<td>11 (8.2)</td>
<td>39 (8.0)</td>
<td>83 (9.6)</td>
<td>336 (15.7)</td>
<td>211 (12.0)</td>
<td>253 (11.8)</td>
<td>315 (14.0)</td>
<td>164 (7.3)</td>
<td>1332 (11.1)</td>
</tr>
<tr>
<td>Sports facility, n (%)</td>
<td>55 (40.7)</td>
<td>134 (27.4)</td>
<td>147 (16.9)</td>
<td>317 (14.8)</td>
<td>198 (11.3)</td>
<td>173 (8.1)</td>
<td>164 (7.3)</td>
<td>144 (6.4)</td>
<td>1332 (11.1)</td>
</tr>
<tr>
<td>Shopping malls, shops bulks, n (%)</td>
<td>0 (0.0)</td>
<td>20 (4.1)</td>
<td>65 (7.5)</td>
<td>121 (5.7)</td>
<td>121 (5.7)</td>
<td>151 (7.0)</td>
<td>250 (11.1)</td>
<td>237 (10.5)</td>
<td>965 (8.0)</td>
</tr>
<tr>
<td>Voluntary union association, n (%)</td>
<td>0 (0.0)</td>
<td>17 (3.5)</td>
<td>74 (8.5)</td>
<td>90 (4.2)</td>
<td>117 (6.7)</td>
<td>146 (6.8)</td>
<td>221 (9.8)</td>
<td>210 (9.3)</td>
<td>875 (7.3)</td>
</tr>
<tr>
<td>Attractions recreational areas, n (%)</td>
<td>15 (11.1)</td>
<td>58 (11.8)</td>
<td>70 (8.1)</td>
<td>139 (6.5)</td>
<td>101 (5.8)</td>
<td>139 (6.5)</td>
<td>105 (4.7)</td>
<td>102 (4.5)</td>
<td>729 (6.1)</td>
</tr>
<tr>
<td>Health clinics, n (%)</td>
<td>11 (8.2)</td>
<td>28 (5.7)</td>
<td>43 (5.0)</td>
<td>113 (5.3)</td>
<td>98 (5.6)</td>
<td>118 (5.5)</td>
<td>118 (5.2)</td>
<td>94 (4.2)</td>
<td>623 (5.2)</td>
</tr>
<tr>
<td>Residential areas, n (%)</td>
<td>3 (2.2)</td>
<td>10 (2.0)</td>
<td>19 (2.2)</td>
<td>58 (2.7)</td>
<td>58 (3.3)</td>
<td>120 (5.6)</td>
<td>141 (6.3)</td>
<td>175 (7.8)</td>
<td>584 (4.9)</td>
</tr>
<tr>
<td>Public building, n (%)</td>
<td>11 (8.2)</td>
<td>18 (3.7)</td>
<td>40 (4.6)</td>
<td>98 (4.6)</td>
<td>65 (3.7)</td>
<td>82 (3.8)</td>
<td>54 (2.4)</td>
<td>98 (4.3)</td>
<td>466 (3.9)</td>
</tr>
<tr>
<td>Church community center, n (%)</td>
<td>1 (0.7)</td>
<td>0 (0.0)</td>
<td>6 (0.7)</td>
<td>24 (1.1)</td>
<td>37 (2.1)</td>
<td>79 (3.7)</td>
<td>64 (2.8)</td>
<td>105 (4.7)</td>
<td>316 (2.6)</td>
</tr>
<tr>
<td>Hotels and conference venues, n (%)</td>
<td>0 (0.0)</td>
<td>11 (2.2)</td>
<td>18 (2.1)</td>
<td>39 (1.8)</td>
<td>40 (2.3)</td>
<td>35 (1.6)</td>
<td>43 (1.9)</td>
<td>40 (1.8)</td>
<td>226 (1.9)</td>
</tr>
<tr>
<td>Transportation facility, n (%)</td>
<td>3 (2.2)</td>
<td>6 (1.2)</td>
<td>4 (0.5)</td>
<td>16 (0.8)</td>
<td>17 (1.0)</td>
<td>40 (1.9)</td>
<td>10 (0.4)</td>
<td>22 (1.0)</td>
<td>118 (1.0)</td>
</tr>
<tr>
<td>Other, n (%)</td>
<td>6 (4.4)</td>
<td>36 (7.4)</td>
<td>70 (8.1)</td>
<td>132 (6.2)</td>
<td>161 (9.2)</td>
<td>147 (6.9)</td>
<td>160 (7.1)</td>
<td>130 (5.8)</td>
<td>842 (7.0)</td>
</tr>
</tbody>
</table>

Results: The number of registered AEDs available for public
access defibrillation increased from 135 in 2007 to 12,045
in 2014. In 2014, most AEDs were placed in companies/offices
(28.7%, n = 3461), followed by school/education facilities (12.5%,
n = 1508) and sports facilities (11.1%, n = 1332). Overall, few AEDs
were deployed in residential areas (4.9%, n = 584) and transportation
facilities (1.0%, n = 118). Table 1 shows temporal changes in
AED deployment according to type of location. AED accessibility
24/7 increased from 11% in 2007 to 29% in 2014, with residential
areas having the highest 24/7 accessibility (78.6%, n = 459),followed
by churches/community centers (66.8%, n = 211), and transportation
facilities (55.9%, n = 66). Only 10.9% (n = 376) of AEDs placed in
companies/offices were accessible 24/7.

Conclusions: The number of AEDs registered in the Danish AED
network and, thus, publicly available has markedly increased during
2007–2014, with companies/offices, school/education facilities,
and sport facilities as the most frequent places of AED deployment.
However, only 10.9% of AEDs placed at companies/offices had 24/7
accessibility.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.024
AS13

Teaching CPR in secondary schools improves the rate of bystander CPR in a city and its neighbourhoods: Results of #SCUOLESICURE project

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2 Pavia nel Cuore/Robbio nel Cuore/School of Anesthesia and Intensive Care, University of Pavia, Pavia/Robbio (PV), Italy
3 Division of Cardiology, Fondazione IRCCS Policlinico San Matteo, Pavia, Italy
4 SOREU della Pianura, AREU, Milano, Italy
5 University of Pavia, Pavia, Italy
6 AAT 118 Pavia, Fondazione IRCCS Policlinico San Matteo, Pavia, Italy

Purpose: CPR training to the general population is carried out continuously in our province through BLS/AED courses. The aim of our study was to assess if a specific project to teach CPR to all final-year students and teachers of secondary schools of Pavia city, named #SCUOLESICURE (literally “SAFESCHOOLS”), has improved the bystander CPR rate in Pavia and its neighbourhoods.

Methods: We considered all the OHCA, excluding those that were EMS witnessed, wherein resuscitation was attempted that were enrolled in the cardiac arrest registry of Pavia Province (Pavia CARe). We evaluated the bystander CPR rate in Pavia and in the cities around 10 km (Pavia district) in the 4 months before the project in the schools of Pavia city (October 2014–January 2015 – Period 1) and the percentage of bystander CPR 4 months after the end of the project in the same zone (September 2015–December 2015 – Period 2). We compared the data of Pavia district with data of the whole province.

Results: Considering the whole province, there were 142 OHCA wherein resuscitation was attempted (90 of them witnessed by bystander) in Period 1 and 128 (90 witnessed) in Period 2. The bystander CPR rate was 32.4% (40% for witnessed) before the project and 35% (41% for witnessed) after the project in the entire province. In Pavia district, there were 66 OHCA in Period 1 (44 witnessed) and 57 in Period 2 (41 witnessed), and the bystander CPR rate increased from 28.8% before the project (34% for witnessed) to 42% after the project (46.3% for witnessed).

Conclusions: The bystander CPR rate increased by approximately 12–13% in Pavia district after the project #SCUOLESICURE in the schools of Pavia city. Considering that the rate remained stable for the province, it is reasonable to believe that teaching CPR in schools played a positive role in this improvement.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.025

AS14

What can dispatchers learn from closed-circuit television (CCTV) recordings of out-of-hospital cardiac arrest?

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2 Copenhagen Academy for Medical Education and Simulation, Copenhagen, Denmark

Purpose: Dispatcher-assisted telephone cardiopulmonary resuscitation (DA-CPR) is highlighted in the 2015 Resuscitation Guidelines. The dispatchers have an important role and their situation awareness in this complex nonvisual environment depends on the communication with the caller. We aimed to explore what dispatchers could learn from seeing a CCTV recording of a case of out-of-hospital cardiac arrest (OHCA) that they have handled themselves.

Method: We performed ten explorative and semi-structured interviews with dispatchers who previously had handled an emergency call concerning OHCA captured on CCTV. Before the dispatchers saw the CCTV recording, we analysed the dispatchers’ perception of the bystander response based on an audio-recording of the call. Situations were illustrated with LEGO-figures. Afterwards, we analysed their reflections of what they have learned from the CCTV recordings. A qualitative analysis based on thematic content was performed.

Results: The main learning points from seeing CCTV recordings were: more focus on how to guide/lead, importance of evaluating cardiopulmonary resuscitation (CPR) and for the dispatchers to have a changeable/unfixed mind set. It was important to make sure that the caller was close to the victim and the caller relayed DA-CPR to the bystanders performing CPR. The resuscitative attempts were not always as sufficient as the dispatchers thought, which emphasised the importance of getting information from bystanders about CPR. Furthermore, the dispatchers have to be open-minded as their first perception of the situation could be insufficient. Therefore, the situation could change regarding the patient’s condition, the number of bystanders present and their competency.

Conclusion: The CCTV seemed to enhance the dispatchers’ situation awareness and gave important knowledge that could be used to improve their normal practice, that is, guidance without visual contact, including better evaluation of the CPR, changeable/unfixed mindset and follow-up as the situation can change.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.026

AS15

Advanced cardiac life support (ACLS) is all about Airway-Circulation-Leadership-Support (A-C-L-S): A Novel Cardiopulmonary Resuscitation (CPR) teamwork model

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National Taiwan University Hospital, Taipei City, Taiwan

Purpose: CPR is a time-critical, fast-changing, complex, and error-prone medical procedure. Teamwork is vital to the success of high-quality CPR, but so far we lack a simple and easy-to-learn teamwork model. An A-C-L-S team was designed for this purpose.
This article describes the methodology, education, and preliminary results of the A-C-L-S teamwork model.

**Methods:** All ACLS-related technical or non-technical skills were carefully examined and transformed into an A-C-L-S teamwork framework, which is based on four CPR positions: Airway, Circulation, Support, and Leader. (Fig. 1)

A high-fidelity simulation-based training course was designed to help rescuer mastering each CPR position and its related tasks, tools, and mnemonics. Finally, we reviewed CPR videos to evaluate clinical performance metrics during CPR.

**Results:** Between April and May 2011, seven A-C-L-S team training courses were delivered to 52 ED staff (17 residents and 35 nurses, all qualified ACLS providers). After the course, ACLS core technical skills improved significantly in median time of success intubation (429.8 ± 193.0–197.9 ± 112.3 s, p = 0.022), end-tidal capnography interpretation (469.3 ± 281.4–244.6 ± 87.9 s, p = 0.015), laboratory data interpretation (588.4 ± 447.3 ± 112.7 s, p = 0.005), and sonography examination (765.0 ± 381.6–515.5 ± 232.6 s, p = 0.020).

**Conclusions:** The A-C-L-S teamwork model is a multifaceted CPR approach that comprises an ACLS algorithm, learnable–teachable team structure, TeamStepps concept, and CPR assist devices. Its impact on CPR quality and patient outcomes deserve further study.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.027

AS17

**Statistical evaluation of smartphone apps for basic life support training**

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**Ospedali Riuniti University Hospital, Foggia, Italy**

**Purpose of the study:** Smartphones and application programs (apps) are increasingly being employed in medicine and nursing. The young and people using technological devices are protagonists of an evolving way of learning. We aimed to evaluate the quality of current mobile apps for learning of cardiopulmonary resuscitation (CPR). A simple statistical method is proposed. If any critical issues were identified in the learning process of CPR, strategies for improving existing apps would be pointed out.

**Materials and methods:** CPR courses were held from August to November 2015, and 150 laypersons (age: 18–65; median: 25 years) were randomized to either use a smartphone app or not. “Viva! CRP” app was illustrated and employed by randomized participants. Instructors used the skill test form by Italian Resuscitation Council for a blind evaluation of practical abilities. The 16 items were grouped in 4 categories: A, Airways; B, Breathing; C, Circulation; D, Defibrillation. For each rescuer, all items were scored and summed in overall and four categorical scores. R statistical program was used for analysis.

**Results:** Median scores were 15 (range: 12–16) and 14 (range: 8–16), respectively, in the app and non-app group. A significant difference exists between groups (Mann–Whitney–Wilcoxon test, p-value = 0.01). Even if all trainees were accustomed to apps, a psychometrically tested in terms of reliability (internal consistency and temporal stability) and validity (content, criterion and construct). The ECG-SES’ internal consistency was evidenced by calculating the Cronbach’s alpha coefficient (α); its temporal stability was investigated by calculating the Pearson correlation coefficient (r) between the participants’ results on a test–retest separated by a 4-week interval. The content validity index of the items (I-CVI) and the scale (S-CVI) was calculated based on the reviews of a panel of 16 experts. Criterion validity was explored by correlating the participants’ results on the ECG-SES with their results on the New General Self-Efficacy Scale (NGSE). Construct validity was investigated by performing Principal Component Analysis (PCA) and known-group analysis.

**Results:** The excellent reliability of the ECG-SES was evidenced by its internal consistency (α = 0.98) and its temporal stability at the 4-week re-test (r = 0.81; p < 0.01). The ECG-SES’ content validity was also excellent (all items’ I-CVI = 0.94–1; S-CVI = 0.99). A strong, significant correlation between the NGSE and the ECG-SES (r = 0.70; p < 0.01) showed its criterion validity. Corroborating the ECG-SES’ construct validity, PCA revealed that all its items loaded on a single factor that explained 74.6% of the total variance found. Furthermore, known-groups analysis showed the ECG-SES’ ability to detect expected differences in self-efficacy between groups with different training experiences (p < 0.01).

**Conclusion:** The ECG-SES showed excellent psychometric properties for measuring the self-efficacy of nursing students in basic ECG interpretation.

Reference


http://dx.doi.org/10.1016/j.resuscitation.2016.07.028

EGC interpretation self-efficacy scale

José Manuel Hernández-Padilla, José Granero-Molina, Fiona Suthers, Kata Füge, Leonel Sao-Romao-Preto, Cayetano Fernández-Sola.

**Purpose:** Research suggests that nurses and nursing students lack competence in basic electrocardiogram (ECG) interpretation. Self-efficacy is considered to be paramount in the development of one’s competence. The aim of this study was to develop and psychometrically evaluate a scale to assess self-efficacy of nursing students in basic ECG interpretation.

**Materials and methods:** Observational cross-sectional study with a convenience sample of 293 nursing students. The basic ECG interpretation self-efficacy scale (ECG-SES) was developed and psychometrically tested in terms of reliability (internal consistency and temporal stability) and validity (content, criterion and construct). The ECG-SES’ internal consistency was evidenced by calculating the Cronbach’s alpha coefficient (α); its temporal stability was investigated by calculating the Pearson correlation coefficient (r) between the participants’ results on a test–retest separated by a 4-week interval. The content validity index of the items (I-CVI) and the scale (S-CVI) was calculated based on the reviews of a panel of 16 experts. Criterion validity was explored by correlating the participants’ results on the ECG-SES with their results on the New General Self-Efficacy Scale (NGSE). Construct validity was investigated by performing Principal Component Analysis (PCA) and known-group analysis.

**Results:** The excellent reliability of the ECG-SES was evidenced by its internal consistency (α = 0.98) and its temporal stability at the 4-week re-test (r = 0.81; p < 0.01). The ECG-SES’ content validity was also excellent (all items’ I-CVI = 0.94–1; S-CVI = 0.99). A strong, significant correlation between the NGSE and the ECG-SES (r = 0.70; p < 0.01) showed its criterion validity. Corroborating the ECG-SES’ construct validity, PCA revealed that all its items loaded on a single factor that explained 74.6% of the total variance found. Furthermore, known-groups analysis showed the ECG-SES’ ability to detect expected differences in self-efficacy between groups with different training experiences (p < 0.01).

**Conclusion:** The ECG-SES showed excellent psychometric properties for measuring the self-efficacy of nursing students in basic ECG interpretation.

Reference


http://dx.doi.org/10.1016/j.resuscitation.2016.07.028
strong relationship was found between age and scores (Spearman’s correlation, p-value = 0.01). With respect to categories (A, B, C, and D), the app we tested enhanced only group D abilities, regarding the utilization of automated external defibrillator (Mann–Whitney–Wilcoxon test, p-value = 0.004).

Conclusions: Smartphone apps can significantly improve CPR learning, as regards practical abilities. Mobile apps are useful for training, especially for the youth. However, not all categories of skill test (A, B, C, and D) are enhanced. An ideal app for CPR learning should improve all types of practical skills. In such a direction, existing apps could be refined and new software products could be developed to optimize CPR training.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.029

AS18

The art of education: Why do we teach skills the way we do?

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Purpose: When did you last feel like a square peg in a round hole? In two recent studies comparing the effectiveness of a widely advocated 4-stage skill teaching approach (4SA) and a more traditional 2-stage approach (2SA), we observed that compliance to the 4SA was significantly lower than 2SA. In a follow-up multi-faceted qualitative study, we sought to understand why.

Methods: Through a series of surveys, follow-up interviews, a focus group and a teacher debrief, we sought to understand the educator’s perspective of 4SA in this qualitative review. Data were gathered from advanced life support (ALS) instructors and other clinical educators shortly after learning and practising the 4SA. Analysis principles from grounded theory were applied to this phenomenological study, and thematic analysis of the data was performed.

Results: Common emerging themes include the cognitive load on the teacher, and the art of education, which is sometimes in conflict with an understanding of the benefits, difficulties, and practicalities of employing specific teaching tools and strategies.

Conclusions: The overarching themes revealed that a pre-defined teaching strategy can be useful for some educators; however, it can hinder the established educator from flourishing in his or her art of teaching. This restriction, intended to improve their efficacy, actually increases their cognitive load. The implementation of such education tools, even when firmly grounded in educational theory, should be flexible in recognising teaching as a dynamic art. As such, teaching and learning are more than a simple activity in which an intellectual transaction occurs. This study forces us to examine: Why do we teach the way we do?

References

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http://dx.doi.org/10.1016/j.resuscitation.2016.07.030

AS19

The educational challenge in 2016: Providing emergency care to migrants and vulnerable people

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2 European Centre of Technological Safety, Kiev, Ukraine

Foreground and rationale: The year 2016 poses threats to emergency medicine practitioners all over Europe. Terrorism, climate changes, and seasonal diseases could be sufficient to challenge emergency medical systems; actually they add to the hardships facing the thousands of migrants who continue to cross into Europe with the unending conflicts in Syria and Iraq.

In these settings, emergency medicine must play its key role of being the last resort for people with no primary healthcare and no alternative.

There has never been a greater need for European countries to recognize the value of effective and well-trained emergency physicians and nurses able to deal with special patients, such as migrants and vulnerable people.

Objective: The aim of the study was to explore and describe problems and difficulties of situations with migrants in emergency care in order to plan for appropriate and effective teaching programme for emergency care providers.

Research design and methods: An explorative study was carried out using a sample of 67 emergency care providers, 15 physicians, 52 registered nurses, 46 women and 21 men, all experienced in emergency care; they documented their experiences of problematic situations.

Results: Results are described as nine main categories that emerged from the data. The health care professionals’ experiences of problematic situations with migrants in emergency care were described as (1) language barriers (2) reliance on authorities (3) different behaviour, (4) contact with relatives, (5) complicating logistic factors, (6) gender roles, (7) patient’s earlier experiences of violence, (8) use of natural remedies and (9) lack of knowledge on specific health care problems of migrants.

Conclusions: The results showed that the main problem was related to communication difficulties including language barriers and cultural dissimilarities. Another key factor is the lack of knowledge on specific health care problems of migrants. In order to mitigate the problems, the use of adequate interpreters is a theoretical possibility whereas using language-free communication tools (cartoons and vignettes) could be a financially effective alternative. Training programmes for emergency care providers must include sessions to improve knowledge about the care of migrants from different parts of the world. The importance of searching for the unique individual perspective is emphasized.1,2

References


http://dx.doi.org/10.1016/j.resuscitation.2016.07.031
AS20

Are primary school children able to perform basic first aid skills? A 3-day first aid program for 9- to 10-year-old children

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**Purpose of the study:** In life-threatening situations, quick first aid can save lives. Our aim was to investigate the extent to which primary school children can learn basic life-saving activities.

**Material and methods:** This study involved 170 schoolchildren (age 9–10 years; 87 girls and 83 boys). Training consisted of three sessions with theoretical and practical skills about first aid. The most important and urgent situations were involved in our study: basic life support (BLS), using an AED, handling an unconscious patient (recovery position), managing bleeding and calling the ambulance. Data collection was made with a self-made questionnaire and observation. The children were tested before, immediately after and 3 months after training. The statistical analysis was conducted with SPSS 22.0 statistical software. For analysis, descriptive statistics, chi-square test, t-test, ANOVA and correlation analysis were used. Results were considered significant in case \( p < 0.05 \).

**Results:** In the pre-test, 34 children (20%) knew the correct chest compression–ventilation rate (30:2). After the training, 165 (97%) and 3 months later 132 (78%) children knew it. Before the training, 24% of the children used direct pressure to the wound in a severely bleeding patient. After the training, 91% and 3 months later 72% of the participants used this method. Before the training 13%, after the training 74%, and 3 months later 41% knew the correct assessment of consciousness. Knowledge retention after 3 months was similar for boys and girls in BLS \((p = 0.837)\), bleeding \((p = 0.696)\) and unconsciousness \((p = 0.59)\). Children who participated previous first aid training did not achieve better result in the pre-test in BLS \((p = 0.558)\), bleeding \((p = 0.592)\) and unconsciousness \((p = 0.559)\).

**Conclusions:** Children 9- to 10 years old are able to perform basic life-saving skills. Knowledge retention after 3 months is acceptable for skills, but thinking along algorithms is difficult for these children.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.032

AS21

Evaluation of instructor-led debriefing in Advanced Life Support courses: A qualitative study

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2 Birmingham Heartlands Hospital, Birmingham, UK
3 Resuscitation Council UK, London, UK
4 Royal College of Physicians, London, UK
5 University of Warwick, Warwick, UK

**Purpose of the study:** Resuscitation training is multifaceted and encompasses leadership skills, teamwork and complex technical skills such as chest compression, ventilation and defibrillation. Despite the advent of e-learning solutions, the mainstay of resuscitation training remains in simulation setting where learners practice within a safe environment and an experienced instructor can provide immediate debriefing to the learner. Debriefing in healthcare is defined as ‘a facilitator-led participant discussion of events with reflection and assimilation of learning into practice’.

There is a lack of evidence behind how debriefing should be given and its impact on performance in resuscitation training. The learning conversation was introduced to the ALS course in 2010, but to date there has been no critical evaluation. The aim of this qualitative study was to develop an understanding of the key components of debriefing and how we can improve its delivery.

**Materials and methods:** Seven focus groups of 20 ALS instructors and 17 ALS candidates were conducted between April and October 2015 until data saturation. Only instructors and candidates who underwent ALS course post 2010 were included. Discussions were audio-recorded and transcribed. An iterative thematic analysis was completed using nVIVO software.

**Results:** Four key themes were identified amongst instructors and candidates:

1. High-quality debriefing is crucial to candidates’ effective learning.
2. Quality of debriefing is variable. Both groups described experience of both Pendleton and Learning Conversation styles of debriefing. Some instructors found effective debriefing challenging. More resources should be made available.
3. The amount of time available is a barrier to high-quality debriefing. The time element not only features in debriefing after each scenario but also in shortened course format.
4. Honesty and trust is key to effective debriefing in both peer group and instructor feedback.

**Conclusions:** Debriefing is considered to be an important component of ALS courses. There may be a need to develop resources to help instructors deliver more effective debriefing.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.033
AS22

Educational training with the TrueCPR® feedback device significantly improves chest compression quality in lay rescuers

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Purpose of the study: Guidelines of the European Resuscitation Council and the American Heart Association indicate the need for effective chest compressions (CC) during cardiopulmonary resuscitation (CPR). The aim of this study was to determine whether the use of the TrueCPR feedback device (Physio-Control, Redmond, WA, USA) training improved the quality of subsequent CCs during Basic Life Support (BLS).

Materials and methods: All participants underwent a 3-h training on BLS according to the ERC 2015 guidelines. At the end of the course, they performed 2-min compression-only CPR (test A) using a Resusci Anne SkillReporter manikin (Laerdal, Stavanger, Norway). Afterwards, the participants received a 5-min audio–visual demonstration of the TrueCPR feedback device, followed by a 5-min hands-on training session with TrueCPR. After the training, each participant performed a 2-min compression-only CPR (test B) once again. The A and B test results were compared as for the Effective Compression Ratio (ECR), defined as effective compressions [%] multiplied by flow time [%].

Results: The study comprised 186 lay people and was conducted between November 2015 and March 2016. Participants were 52.7% female; the mean age was 33.2 ± 8.4 years, mean height 174.5 ± 8.5 cm, mean weight 66.5 ± 12.5 kg, mean BMI 23.5 ± 2.7 kg m⁻². Sex, height, weight or BMI were not significantly associated with the ECR score. The ECR equalled 0.21 (interquartile range [IQR], 0.09–0.32) for test A, and 0.39 (IQR, 0.12–0.42) for test B. The ECR differences between the tests were statistically significant (p = .007).

Conclusions: The use of the TrueCPR feedback device significantly improves the CC quality in terms of the ECR parameter.

Reference


http://dx.doi.org/10.1016/j.resuscitation.2016.07.034

AS23

Twitter verse of Resuscitation 2015 – The Guidelines Congress

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Purpose of the study: Medical conferences on resuscitation enable exchange of scientific information, knowledge, and discussion on research results. Popularity of communication via modern emerging technologies is building up and growing rapidly among conference attendees. Today, Twitter has proven to be a potent mechanism for disseminating educational information in different medical fields. However, there prevails a sparseness of data illustrating Twitter activity regarding European Resuscitation Council (ERC) conferences. The aim of our study was to identify tweets and re-tweets about Resuscitation 2015 – The Guidelines Congress (Resus2015).

Materials and methods: Prior to Resus2015 the hashtag #erc15prague was registered within Symplur. People were encouraged to include #erc15prague in every conference related tweet. On 9th November 2015, using the ‘TwitteR’ package, we obtained a database containing every tweet produced between 28th of October and 1st of November with #erc15prague. #erc15prague was registered within Symplur. People were encouraged to include #erc15prague in every conference related tweet. On 9th November 2015, using the ’TwitteR’ package, we obtained a database containing every tweet produced between 28th of October and 1st of November with #erc15prague.

Results: For the time period, there were a total of 2149 #erc15prague tweets. One third of them (33%) were original tweets, while 67% (n = 1435) were re-tweets. We identified 451 different Twitter user accounts from which #erc15prague tweets were posted. The difference between the median and mean number of #erc15prague per Twitter user (1 and 4.7, respectively) indicates majority of #erc15prague tweets originates from a relatively small number of contributors. Twitter users network at Resus2015 is shown in Fig. 1.

Conclusions: This is the first study identifying tweets and re-tweets about ERC conference. Although we have demonstrated a colourful tweeting and re-tweeting activity about Resus2015, majority of #erc15prague tweets originated from small number of Twitter users. Nevertheless, they were greatly re-tweeted, indicating a substantial impact on the Twitter users’ virtual network.

Fig. 1. Twitter users network at Resuscitation 2015 – The Guidelines Congress. Each circle, also called a node, represents all entries that were re-tweeted. Size of the node is proportional to the number of re-tweets. Lines connecting the nodes, also called edges, inform if the connection between Twitter users is reciprocal or not. Only Twitter users re-tweeted more than 20 times are shown on the plot.
In future studies we recommend further analysis of Twitter users actively tweeting and re-tweeting about ERC conferences, separating those physically present, compared to those tweeting away from the conference.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.035

AS24

Long-term follow-up after an out-of-hospital cardiac arrest: An important challenge that should be addressed. The results of the first year of Pavia CARE

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Purpose: Many registries have emerged worldwide to measure out-of-hospital cardiac arrests (OHCA) and to improve survival, but many of them stop their follow-up at 1 month after the event. The power of our registry is to have a long follow-up (5 years) and to be one of the first created according to the 2014 Utstein style.

Methods: All the patients who suffered an OHCA of any aetiology in our Province (~550,000 inhabitants) from October 2014 onwards were enrolled in the registry. The main outcome was survival at 1 month, and the secondary outcomes were survival at 6 months and then every year until 5 years after the OHCA.

Results: In the first 12 months, we enrolled 748 patients and in 478 of them [male 60.9%; mean age of 74.7 ± 14.3 years] a CPR was attempted. The mean EMS response time was 11:38 ± 3:38 min. 78.4% of OHCA occurred at home, 10.2% in nursing facilities, 1.9% during work, 0.4% during sport and 9.1% in a public location; 53.8% were witnessed by bystander, 15.8% by EMS and the others were unwitnessed. The rate of bystander CPR was 29.7%, whilst an AED was used before the EMS arrival in 1.7% of cases, with a shock delivered in 37.5% of them. Concerning the aetiology, the vast majority (94.4%) were medical. The first rhythm was shockable in 15.2% and non-shockable in the remaining 84.8%. The survival results, presented according to 2014 Utstein recommendation, are presented in Table 1.

<table>
<thead>
<tr>
<th>EMS with witnessed</th>
<th>All EMS treated</th>
<th>Shockable bystander witnessed</th>
<th>Shockable bystander Excluded</th>
<th>Non-shockable witnessed</th>
</tr>
</thead>
<tbody>
<tr>
<td>included (n=402)</td>
<td>(n=478)</td>
<td>(n=50)</td>
<td>(n=34)</td>
<td>(n=207)</td>
</tr>
<tr>
<td>n=79</td>
<td>n=35</td>
<td>n=26</td>
<td>n=29</td>
<td>n=24</td>
</tr>
<tr>
<td>(16.5%)</td>
<td>(7.3%)</td>
<td>(5.4%)</td>
<td>(6%)</td>
<td>(5%)</td>
</tr>
<tr>
<td>n=14</td>
<td>n=19</td>
<td>n=14</td>
<td>n=18</td>
<td>n=14</td>
</tr>
<tr>
<td>(38%)</td>
<td>(38%)</td>
<td>(28%)</td>
<td>(36%)</td>
<td>(28%)</td>
</tr>
<tr>
<td>n=12</td>
<td>n=14</td>
<td>n=14</td>
<td>n=12</td>
<td>n=12</td>
</tr>
<tr>
<td>(41.2%)</td>
<td>(41.2%)</td>
<td>(35.3%)</td>
<td>(41.2%)</td>
<td>(35.3%)</td>
</tr>
<tr>
<td>n=3</td>
<td>n=3</td>
<td>n=1</td>
<td>n=2</td>
<td>n=1</td>
</tr>
<tr>
<td>(8.7%)</td>
<td>(1.4%)</td>
<td>(0.5%)</td>
<td>(1%)</td>
<td>(0.5%)</td>
</tr>
</tbody>
</table>

Conclusions: Our outcome results indicate a follow-up longer than the standard 1-month is very important because survival rates can change. We believe that our registry, due to its long follow-up, will provide interesting elements to better understand the long-term issues to improve OHCA survival.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.036

AS25

Perception of inappropriate cardiopulmonary resuscitation: A qualitative study

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Purpose of the study: To investigate emergency nurses' experiences and feelings about perceived inappropriate cardiopulmonary resuscitation (PICR).

Materials and methods: A qualitative study using a phenomenologic methodology was conducted using individual semi-structured interviews of emergency nurses involved in the treatment of out-of-hospital cardiac arrest in Flanders, Belgium. The interviews were analysed from a nurse perspective by two researchers.

Results: Twelve emergency nurses (7 males, mean age/experience/out-of-hospital experience 43/21/13 years) were interviewed. The main indicators of PICR were the expected outcome and age of the patients, respecting their will, the quality of resuscitation techniques and adherence to resuscitation protocols. Some nurses cited the importance of a well-functioning team, open communication, shared decision-making and mutual respect as major factors in decreasing PICR. Well-educated health care providers following the guidelines led to better cooperation, mutual trust and communication even in newly formed teams. The personality of the physician had a major influence on team functioning and communication. The greater the hierarchical difference between physician and nurse, the more difficult was communication. Nurses saw themselves as the watchers of humanity during resuscitation. They liked to be recognized in that role and to be involved in decisions. Feelings of frustration and anger were associated with PICR. Nurses took a reserved attitude during PICR. They mostly used their social environment at work and at home to express their feelings, but some discussed their feelings
or disagreements with the physician if they were allowed to. There were no long-term negative feelings associated with PICR in the treatment of out-of-hospital cardiac arrest.

**Conclusions:** Knowledge of resuscitation guidelines and techniques, the composition of the resuscitation team, communication and the personality of the physician had a major impact on nurses’ perception of appropriateness of cardiopulmonary resuscitation. There were no long-term negative feelings associated with PICR.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.037

**AS26**

**Ethical decisions in cardiopulmonary reanimation in the emergency department**

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**Purpose of the study:** Romania does not have a clear legal framework permitting non-initiation of resuscitation maneuvers. This study aimed to measure the degree of satisfaction of the healthcare providers in an emergency department (ED) regarding CPR efforts and their perception on useless CPR.

**Materials and methods:** Survey conducted among healthcare providers (doctors and nurses) in a university ED in Romania consisting of a questionnaire with 27 items. We took demographic and educational characteristics of the healthcare provider into account, together with working conditions and ethical work climate. There are questions about their working conditions and teamwork within their professional environment. Four-level Likert items are used where appropriate.

**Results:** Thirty-five questionnaires were completed by the medical personnel (19 doctors and 16 nurses, mean age 33.35 ± 7.5 years, working on average 47.70 ± 8.6 hours/week in clinical setting and with 4.64 ± 3.05 years of experience in the ED; 34.28% totally agreed they had sufficient information on CPR practices and collaboration within a multidisciplinary team; 51.42% disagreed that general population appreciates their work but only 5.71% stated the intention of leaving actual position or current profession. Regarding the CPR practices, 88.5% stated that family presence during resuscitation is allowed but 82.85% assured emotional support for the family; 34.28% revealed the absence of a debriefing after CPR attempts. When referring to perception of useless CPR, we identified that it is present in 23.06% of cases and poor quality of initial CPR-basic life support (77.14%), presence of advanced cancer disease (60%) and the presence of a non-shockable rhythm (57.14%) are the main factors in perception of useless CPR. On the other hand, an initial shockable rhythm (85.71%), CPR in children (100%) and CPR in pregnancy (97.14%) are situations when CPR is considered adequate.

**Conclusions:** The current resuscitation practice is motivated by the assumption that, in the absence of an advanced directive or do not resuscitate (DNR) order, patients are resuscitated at any cost and in any probability of success. There is a high percentage of cases wherein CPR is considered useless.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.038

**AS27**

**Family presence during cardiopulmonary resuscitation**

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Sudden cardiac arrest often has negative consequences for patients and their relatives. The participation of the family in end-of-life care is commonly accepted, whereas family presence during sudden cardiac arrest is highly controversial. In most cases, family members are not allowed to witness cardiopulmonary resuscitation of their loved ones.

The main objective of the research presented in this paper was to investigate the views of health care professionals concerning the presence of the family members during cardiopulmonary resuscitation.

The following tools were used: the Family Presence Risk-Benefit Scale, the Family Presence Self-confidence Scale created by Renne Twibell, as well as an original questionnaire verifying opinions and sociodemographic variables of respondents. The research was conducted among 547 health care professionals working in the following facilities: Polish Medical Air Rescue, Independent Public Complex of Health Care Facilities in Łęczna, Provincial Emergency Ambulance Service in Lublin, Independent Public Clinical Hospital No 4 in Lublin and Independent Public Clinical Hospital No 1 in Lublin.

Analysis of the results showed that almost 3/5 of the respondents had negative opinions concerning the presence of the family during cardiopulmonary resuscitation (answers: definitely not – 29.43%, probably not – 28.34%). Mean scores on the FPR-BS was 2.49 (±0.66) and on the FPS-CS was 3.36 (±0.74). The conducted regression analysis indicates that variables increasing the results on the FPR-BS are: The Family Presence Risk-Benefit Scale, place of residence, age of the respondents, the frequency of performing resuscitation in the presence of the family and the number of relatives allowed to witness the cardiopulmonary resuscitation (p < 0.001).

The analysis of the results showed a negative attitude towards family presence during cardiopulmonary resuscitation among health care professionals in the sample group. According to respondents, family presence during cardiopulmonary resuscitation brings more risks than benefits.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.039
AS28

The multi-year impact of continuing a comprehensive dispatcher-assisted CPR guideline on bystander CPR and survival from out-of-hospital cardiac arrest in a horizontal dispatch system

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Purpose: Resuscitation guidelines indicate pre-arrival dispatcher-assisted telephone CPR (DATCPR) instructions and measurement to increase the rate of bystander CPR (BCPR); however, its short-term impact on survival is unsatisfied. This study aimed to investigate the multi-year impact of continuing a comprehensive program implementation of DATCPR guidelines on BCPR and survival from OHCA in a horizontal computer-aided dispatch (CAD) system.

Methods: A centralized CAD system in a metropolitan EMS is studied. Routinely, in system, the time from an EMS call to ambulance dispatch should occur within 60 s. A comprehensive program to enhance DATCPR included guideline-based protocol changes, staff training, ergonomic CAD interface, computerized audit, feedback, and leadership rebuilding has been implemented and consistently run. Proportions of BCPR and survival 3 years after implementation (P1), by collecting a 6-month database from a community-wide OHCA e-registry, are compared with that of the same month period in the previous year as the control group (P0), using regression analysis for statistics.

Results: There were 3582 OHCA patients (1734 P0, 1848 P1; 65% male, median age 76 [IQR: 58–86]). The rate of BCPR went from 17.6% in P0 to 35.3% in P1 (p < 0.001). Outcome of sustained return to spontaneous circulation (ROSC) was significantly higher in P1 compared to P0 (26.8% vs. 22.3% p = 0.02), as was survival to hospital discharge (10.6% in P1 vs. 5.7% in P0 p < 0.001), and good neurological outcome (CPC 1 or 2: 6.7% in P1 vs. 2.1% in P0 p < 0.001). After adjusting for witnessed arrest, shockable rhythms, age, sex, pre-hospital time intervals, endotracheal intubation, intravenous epinephrine, extracorporeal CPR, and targeted temperature management, good neurological outcome was still significantly higher in P1 vs. P0 (adjusted odds ratios: 2.1 [95% CI 1.2–3.9]).

Conclusions: Multi-year continuous implementation of a comprehensive program of DATCPR in a metropolitan horizontal CAD system was associated with significant improvements in the rates of BCPR and good neurological outcome after OHCA.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.040

AS29

Hyperinvasive approach prolongs the time window for favorable outcomes in refractory out-of-hospital cardiac arrest: A preliminary analysis of the “Prague OHCA Study”

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Background: A randomized study compares a hyperinvasive (H) approach (prehospital intra-arrest hypothermia, mechanical compressions, in-hospital extracorporeal life support, and invasive investigation) with standard (S) care in refractory out-of-hospital cardiac arrest (OHCA) of cardiac origin. This analysis evaluates whether the H approach prolongs the time window for favorable outcomes.

Methods: Patients with witnessed refractory OHCA without return of spontaneous circulation (ROSC) were randomized to H or S arms during ongoing cardiopulmonary resuscitation (CPR). Favorable outcomes were defined as 30-day survival with both neurological and cardiac recovery. Relationship was determined to CPR time, defined as time to ROSC, death or ECLS.

Results: Sixty-five patients were randomized (S = 32; H = 33). Nine patients crossed over from S to H (S = 23; H + Cross = 42). Patients were aged 55.0 (52.0–59.0) years; 55 (85%) were male. The mean time points of randomization during ongoing CPR were 22 (18.0–27.3) and 25 (22.0–27.0) min in S and H, respectively, p = 0.32. Favorable outcomes were reached in 30% of patients in S and 36% patients in H + Cross arm, p = NS. In favorable outcomes patients, CPR time in the S arm was similar to patients who attained ROSC in H + Cross arm. However, patients connected to ECLS for ongoing cardiac arrest in the H + Cross arm and attained favorable outcomes had significantly longer CPR times compared to both S arm and ROSC patients in H + Cross arm (56.5 [49.9–74.2] vs. 20 [19.0–30.5] vs. 27 [17.5–45.1] min, p = 0.004 and p = 0.02, respectively).

Conclusion: Hyperinvasive approach encompassing ECLS prolongs time of CPR with favorable outcomes in refractory OHCA of cardiac origin.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.041

AS30

Dispatchers’ attitude towards telephone CPR: Mind the gap

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Background: Providing telephone-CPR (T-CPR) to callers in OHC is a key demand in the 2010 and, even more so, in the 2015 ERC guidelines.1, 2 Emergency medical dispatchers’ (EMD) attitude towards T-CPR has rarely been examined. This survey aimed to identify obstacles towards implementation of this lifesaving tool.

Methods: A 25-item questionnaire was developed and made accessible online from 1 February to 31 March 2016 via an online survey tool. The German Dispatch Association promoted participation among its members. Data processing was performed using Excel2010.

Results: In total, 469 dispatchers responded, with 98.5% (n = 462) reporting use of T-CPR on a regular basis. Only seven EMD
interventions may enable hospitals to better prioritise recommendations for implementation.

References


http://dx.doi.org/10.1016/j.resuscitation.2016.07.043

AS32

The impact of a CPR feedback device on the quality of chest compressions performed by the attendees to Italian Resuscitation Council annual congress

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Background: There is evidence that even professional rescuers may deliver poor quality of CPR and, more specifically, ineffective chest compression. We evaluated the impact of a CPR feedback device on the quality of chest compression (CC) performed by a supposed highly skilled population of attendees to the 2015 congress of the Italian Resuscitation Council.

Methods: Two-hundred and two attendees were enrolled to perform 2-min CC without feedback, followed, after a 5-min rest, by another 2-min interval of CC with feedback. Moreover, participants were randomly assigned to two groups: “feedback later” (n = 102) in which the first 2-min CC was without the feedback, and the “feedback first” (n = 100), in which the first 2-min CC was with the feedback. The TrueCPR (PhysioControl, Sweden) was used to monitor the percentage of correctly performed CC, CC rate (CC/min), and chest release (CR).

Results: Overall, only 60% of correct CC were performed without feedback, which significantly increased to 80% with feedback (Fig. 1A). In the “feedback later” group, the percentage of correctly performed CC and CR significantly increased during the second 2-min interval of CC with feedback (median value 51% vs. 86%, p = 0.0001 and 71% vs. 84%, p = 0.025, respectively; Fig. 1B). In the “feedback first” group, the percentage of correct CC remained stable during the two CC intervals (71% vs. 80%, p = 0.06), while CR was better without the help of the feedback (70% vs. 93%, p < 0.0001;
Fig. 1C). CC/min was in the recommended range (110–120/min) in all the CC events.

**Conclusions:** In this population of expected highly skilled CC performers, the overall quality was poor. The use of a feedback device significantly improved the quality of CC. When the feedback device was used in the first CC attempt, it played a learning effect reflected in the maintained quality during the closer second CC series.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.044

**AS33**

**Optimizing chest compression rate using systems dynamics: An argument for not exceeding 100 compressions per minute**

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**Introduction:** Despite decades of research on hemodynamics during CPR, there remains a paucity of data describing the blood flow generated by a given chest compression (CC). We have previously shown that CC-generated blood flow during cardiac arrest is oscillatory, with periods of anterograde and retrograde flow. In the present investigation, we sought to determine the effect of CC rate on blood flow oscillations.

**Materials and methods:** CPR was performed on nine domestic swine (~30 kg) using standard physiological monitoring. Flow was measured in the right common carotid. Ventricular fibrillation was electrically induced. Mechanical CC was started after 10 min of untreated VF. CC was delivered at a rate of 50, 75, 100, 125 or 150 compressions per minute (cpm) and at a depth of 2″ for a total of 54 min. CC rates were changed every 2 min and were randomized.

**Results:** The CC-generated oscillatory flow was under-damped, leading to at most two distinct oscillations per compression. A second period of forward flow was evident at CC rates of 100, 75, and 50 (arrows in Fig. 1). Net carotid flow on a per compression basis was significantly less at CC rates > 100 cpm (150 cpm = 0.19 ± 0.02 mL/compression, 100 cpm = 0.33 ± 0.02 mL/compression, 50 cpm = 0.35 ± 0.02 mL/compression, p < 0.05 for 150 vs. 100 and 150 vs. 50 cpm). In part, this is due to the initiation of the next chest compression (dashed vertical lines in Fig. 1) before the oscillations from the current compression have occurred.

**Conclusions:** Chest compression rates faster than 100 cpm interfere with the second period of forward flow, thereby reducing the net forward flow per compression. Rates less than 100 CPM allow for the second forward oscillation to occur.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.045

**AS34**

**Impact of the newly mechanical chest compression machine LifeLine ARM in contrast to standard BLS performed by firefighters**

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**Purpose of this study:** Out-of-hospital cardiac arrest is a major cause of death and morbidity. Current European Resuscitation Council (ERC) 2015 guidelines for cardiopulmonary resuscitation (CPR) state the importance of chest compression (CC) quality, including reduction of the time without compressions during CPR. The aim of our study was to evaluate the new mechanical chest compression device LifeLine ARM (Defibtech, Guilford, CT, USA) by firefighters in a simulated model of cardiac arrest during evacuation with ongoing resuscitation.

**Material and methods:** This study was designed as a randomized, crossover, manikin trial. Sixty-eight firefighters working in the State Fire Service were enrolled. All participants prior to study received 10-min training on manual and mechanical chest compression according to the ERC 2015 guidelines. Manual chest compressions were compared with LifeLine ARM device using the Resusci-Anne manikin (Laerdal, Stavanger, Norway). We simulated an 8-min cardiac resuscitation situation during ambulance transport using CPR training manikins. The primary endpoint was the percentage of correct CC relative to the total number of CC. Secondary endpoints were depth, pressure point, complete pressure release, rate of chest compressions and hands-off time. The measurements were performed in a standard ambulance vehicle during transport on a preferred track of 5.0 km.

**Results:** In the manual group, CC was performed correctly less often than ARM group (33% [interquartile range, IQR, 29–36%] vs. 94% [91–97%], p < 0.001). Median compression frequency in the manual group was 133 [Interquartile Range IQR, 127–144] min⁻¹ and was significantly higher than in the ARM group (100 [IQR, 99–101] min⁻¹) (p < 0.001)

The median CC depth was deeper with LifeLine ARM (55 mm [54–57 mm] vs. 43 mm [39–48 mm]), p < 0.001. The results with ARM group were significantly better than with manual group (p < 0.05) for all the analyzed variables (correct CC, CC rate, correct CC depth, correct pressure point and correct pressure-release).

**Conclusion:** In manikin simulated controlled conditions, during a “patient” transport with ongoing resuscitation, Lifeline ARM mechanical compression device may have clear advantages over manual compression because they increase CPR quality and increase the safety of the rescuer and patient. Further clinical trials are warranted to confirm our results.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.046
Witnesses, bystanders and outcome in paediatric out-of-hospital cardiac arrest


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Purpose of the study: We aimed to study the association between the presence of a bystander or a witness and survival or good outcome to discharge (paediatric overall performance category [POPC] 1 or 2) in paediatric out-of-hospital cardiac arrest (OHCA).

Materials and methods: A prospective study (65 hospitals, 6 countries) using Utstein style with paediatric OHCA admitted to Emergency Departments. Data collection was from 1st June 2014 to 31st March 2016.

Results: We have analysed 86 paediatric OHCA. The median age of the OHCA was 3.5 years (range 0–17.2), 53.5% were male; 34/81 children survived to hospital discharged (five children are still inpatients or missed patients): 13 with POPC 1, 7 with POPC 2, 8 with POPC 3, 4 with POPC 4 and 2 with POPC 5. Cardiac arrest happened at home (43/86), street (16/86), school (4/86) and sporting place (3/86). There was a witness (who may deliver or not cardiopulmonary resuscitation (CPR) in 49/86 OHCA. There was a bystander (who first delivered CPR) in 54/86 OHCA (of whom 10 were health professionals who did not belong to a medical team, 26 parents and 4 other relatives); 16/44 bystanders who were not health professionals received phone instructions.

We did not find an association between the presence of a witness and survival to discharge or survival with good outcome.

We found an association between the presence of a bystander and (a) survival to discharge (26/52, 50% vs. 8/29, 27.6%, \( p = 0.05 \)) and (b) good outcome to discharge (17/52, 32.7% vs. 3/29, 10.3%, \( p = 0.03 \)). There was no significant better outcome when (a) the bystander was a health professional or (b) when the bystander was not a health professional but received phone instructions.

Conclusions: The presence of a bystander immediately starting basic life support seems to be a clear factor of better outcome in case of OHCA in children.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.047
AP001  
**Prehospital acute coronary syndrome: How often do emergency physicians get it right?**

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**Purpose:** Acute coronary syndrome (ACS) is one of the main reasons for hospitalisation and death in Europe. Further, this diagnosis is often made on suspicion in a preclinical setting. The aim of the study is to analyse the positive predictive value of the ACS diagnosis made by emergency physicians in the area of Ulm, Germany.

**Materials and methods:** In this retrospective study, we used all emergency logs from 2013 (NADOKlive® protocols). Emergency physicians wrote one emergency protocol each on an obligatory basis. Inclusion criteria were: Diagnosis of ACS and/or signs of infarction in electrocardiogram. Exclusion criteria were: Emergencies within hospitals, cases with previous troponin test at the general practitioner's, missing documentation and/or death of patient on site. The next step was to compare those diagnoses with the definite diagnoses written in the medical reports of hospitals using their clinical information systems.

**Results:** See Fig. 1. Out of 5169 protocols, we selected 679 using the criteria above. Most of the patients (93.1%; 632/679) were treated by the emergency physician. Out of those, only 49.1% (310/632) actually had an ACS; 6.9% (47/679) of the patients were not treated actively in the ambulance; 55.3% (26/47) of those untreated patients, that is, 3.8% (26/679) of all patients, effectively had an ACS. Conclusion: Our results showed that the positive predictive value of the analysed diagnosis is not high. Regarding the fact that it is often only a suspected diagnosis, early treatment is not overtreatment but is time saving and heart saving. Additionally, it is notable that the prehospital care missed the treatment in 3.8% of cases.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.049

AP002  
**Long-term survival after acute myocardial infarction with or without out-of-hospital cardiac arrest**

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**Purpose:** Out-of-hospital cardiac arrest (OHCA) is a fairly common presentation of ST-elevation myocardial infarction (STEMI). Comparative data describing the real weight of OHCA on the survival rate of STEMI patients are limited to a short- or a mid-term follow-up. The primary outcome of our study was the long-term survival of STEMI patients who underwent a percutaneous coronary intervention (PCI) with or without OHCA.

**Materials and methods:** We retrospectively enrolled 742 STEMI patients treated with emergency PCI from 2011 to 2014 of whom 50 experienced an OHCA (first rhythm 95.7% VF, 4.3% asystole/PEA). Clinical and prehospital data were computed; in-hospital and 4-year mortality were calculated.

**Results:** OHCA patients had a worse clinical presentation (cardiogenic shock 24% vs. 8%, p < 0.001). PCI was successfully performed (TIMI flow 2–3) in 88% of the OHCA patients and 93%
of the non-OHCA one (p = ns). Patients with OHCA had a higher overall mortality (log rank p < 0.0001) and in-hospital mortality (35% vs. 3.2% p < 0.001, log rank p < 0.0001), compared to STEMI patients. However, when considering patients who survived to hospital discharge, long-term survival was similar for both groups (log rank p = 0.57). In the overall population, OHCA, need for both an intra-aortic balloon pump (IABP) and an extra-corporeal membrane oxygenation (ECMO) were independent predictors of long-term mortality at multivariable Cox analysis [HR 2.6 (95% CI 1.3–5.2) p = 0.006; HR 4.8 (95% CI 2.6–9) p < 0.001 and HR 26 (95% CI 8.2–82.3) p < 0.001 respectively]. In OHCA patients, the need of ECMO and number of DC shocks to achieve ROSC were independent predictors of in-hospital mortality [HR 7.2 (95% CI 1.7–31) p < 0.01 and HR 1.1 (95% CI 1–1.2) p = 0.04 respectively].

Conclusions: STEMI patients resuscitated from an OHCA have a worse clinical presentation and worse short-term outcome compared to those without OHCA. Notably, patients surviving the acute phase have the same long-term outcome compared to those without OHCA. It is important to provide better pre-hospital and in-hospital care to give a good chance of long-term survival.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.050

AP003

Acute coronary syndrome without ST elevation in diabetics: Prognostic value of ultrasensitive troponin

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Introduction: The most common form of acute coronary syndrome is without ST segment elevation (NSTEMI) and approximately 31% are diabetics with high ischemic risk: in this group, global mortality remains high despite the progress achieved regarding evaluation of death risk and complications based on risk factors and measurable parameters such as troponin.

Aim: To study specificity of clinical approach, treatment and mortality in diabetic patients admitted to the emergency department with NSTEMI and to determine prognostic value of the ultra-sensitive troponin at 1 and 6 months.

Methods: Prospective study including 81 diabetic patients admitted for NSTEMI to the emergency department.

Results: Average age was 65 ± 10 years with a sex ratio at 1.38. In 82% of the cases, patients consulted the emergency department directly. The median consultation period was 12 h. Associated risk factors where: HTA (70%), dyslipidemia (48%) and tobacco (38%). In 21% of cases, the symptomatology was atypical. In terms of electrocardiographic stratification: 42% of patients showed a T negative wave and 37% a sub-ST segment. In patients consulting in the first 4 h of onset of chest pain, the initial rate of troponin I by a sensitivity test was positive in 56% of cases. The initial rate of troponin and its peak were correlated with a greater risk of death at 6 months (p < 0.05). The median TIMI risk score was 4 and the median Grace score was 111, with a risk of short-term mortality of 1–3% and medium-term mortality of 3–8%. The average length of stay in the emergency department was 50–37 h. In our study, the mortality rate at 1 and 6 months were 3.7% and 12.3%, respectively.

Conclusions: In the presence of ultra-sensitive tests of troponin I, ischemic risk stratification and management of NSTEMI in diabetics could be initiated earlier and more effectively with the collaboration of the emergency physician and cardiologist.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.051

AP004

Survival out-of hospital cardiac arrest in patients with acute myocardial infarction

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Objective: To analyze CPR-related complications experienced by patients with acute myocardial infarction transported in ambulances for PTCA.

Method: Registration of all acute myocardial infarctions transported by ambulances medicalized from April 2005 to December 2014. The analyzed events were ventricular fibrillation and cardiac arrest necessitating resuscitation.

Results: During the study period, 6651 patients were transferred with acute myocardial infarction. The incidence of VF during transport was 4.25% (283 patients); 393 (5.95%) patients required CPR. Mortality during transport was 0.7% (43 exitus). The survival of patients who had VF as the initial rhythm in witnessed CPR was 96%.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.052

AP005

Improving patient selection for refractory out-of-hospital cardiac arrest treated with extracorporeal life support: Preliminary assessment of the OSCAR-ECLS procedure

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Introduction: Despite recent management improvements including extra-corporeal life support (ECLS), in refractory out-of-hospital cardiac arrest (ROHCA), survival with good neurological outcome remains low. In a French referral centre for cardiac assistance, we designed and evaluated an innovative strategy (OSCAR-ECLS) to optimise access to ECLS of ROHCA patients and, thus, reduce the delay from recognition to ECLS implantation.

Methods: This single-centre observational study was conducted in a tertiary teaching hospital in France. The study compared two periods in ROHCA management (10 patients in 12 months during the “Before OSCAR-ECLS” period and 17 patients in 18 months during the “OSCAR-ECLS” period). This second period targeted:

- the use of a new paradigm of ROHCA (two defibrillation failures and 10 min of advanced CPR with no return of spontaneous circulation (ROSC))
- the optimization of patient selection for ECLS and reduction in time to ECLS initiation (i.e., estimated time between collapse and arrival in the catheterization laboratory) to less than 45 min.

Results: Time to ECLS initiation (i.e., no flow + low flow) was 77.5 (67.0–83.0) min before OSCAR-ECLS versus 50.0 (42.0–60.0) during the OSCAR-ECLS period (p < 0.0001), mostly due to a reduction in the time spent on site by the mobile intensive care team: 46.0 (40.0–52.0) min versus 24.0 (16.0–27.0), p = 0.001. Survival at hospital discharge was 10% (1/10) before OSCAR-ECLS and 35.5%...
Comparing intraosseous and intravenous access for out-of-hospital cardiac arrest in Singapore

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**Purposes:** Vascular access in out-of-hospital cardiac arrest (OHCA) patients is challenging. Locally, emergency ambulance paramedics have a 50% success rate of obtaining an intravenous (IV) access in order to administer epinephrine. The aim is to evaluate the use of intraosseous (IO) access in addition to IV to determine if there is improvement in return of spontaneous circulation (ROSC).

**Methods:** This is a prospective, parallel-group, cluster-randomised, crossover study involving OHCA adult and paediatric patients comparing 'IV only' against 'IV + IO', where if 2 IV attempts failed or took more than 90 s, paramedics may have 2 attempts of IO. Exclusion criteria for IO were contraindications to IO. Primary outcome was ROSC. Secondary outcomes were insertion success rate, epinephrine administration, time to epinephrine and survival outcome.

**Results:** Based on results (prior to crossover) from September to December 2014, there were 251 patients in the 'IV only' arm and 307 patients in the 'IV + IO' arm, baseline characteristics were similar. There were more successful vascular access and prehospital epinephrine administered in 'IV + IO' compared to 'IV only' (69.4% vs. 53%, p < 0.001, 62.5% vs. 47.8%, p < 0.001, respectively). There were 38 IO attempts in 'IV + IO', of which 5 failed as the first attempt was unsuccessful but no second attempt was made. Median time to epinephrine was similar in both 'IV + IO' and 'IV only' arms (10 [IQR 7–16] min vs. 11 [IQR 7–18] min, respectively, p = 0.104), also pre-hospital or hospital ROSC (8.5% vs. 10%, p = 0.558, 25.7% vs. 26.7%, p = 0.847, respectively), and survival to discharge or 30 days and neurological outcome of CPC ≤ 2 (3.9% vs. 5.6% p = 0.421, 2.6% vs. 4.8% p = 0.178, respectively).

**Conclusions:** The use of IO in addition to IV led to higher vascular success rate and prehospital epinephrine administration. However, it was not statistically significant for ROSC, survival to discharge or 30 days or good neurological outcome.
The time interval between endotracheal intubation success and return of spontaneous circulation in OHCA patient with intracranial hemorrhage

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Objective: The incidence of out-of-hospital cardiac arrest (OHCA) patients due to intracranial hemorrhage (ICH) is relatively higher in East Asia than in the United States or Europe. Although several theories have been suggested, the mechanism of arrest due to ICH is unclear. Empirically, there is a tendency of shorter time interval between endotracheal intubation success (ETS) and return to spontaneous circulation (ROSC) in arrests due to ICH compared to other causes. Therefore, we compared the time interval between ETS and ROSC in ICH group and non-ICH group.

Methods: A retrospective observational study based on a prospective OHCA registry was conducted in an emergency department (ED) at two university hospitals from January 2009 to January 2014. Patient variables, according to Utstein-style, about OHCA and time interval during ACLS at ED were analyzed. Data are presented as medians with 25th and 75th percentiles.

Result: In total, 370 subjects were included in this study: 53 and 317 patients were in the ICH and non-ICH groups, respectively. Among the Utstein variables, there were statistically significant between-group differences for gender and age. The time interval from ED arrival to ETS was 3 (2–5) min in the ICH group and 3 (2–4) min in the non-ICH group (p = 0.247). However, the time interval from ETS to ROSC was 4 (1–8) min in the ICH group and 6 (2–12) minutes in the non-ICH group (p = 0.036).

Conclusion: There was a significantly shorter time interval from ETS to ROSC in the ICH group than in the non-ICH group.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.056

AP009

Correlation of airway parameters under current resuscitation guideline: An observational study

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Purpose of the study: Hyperventilation and prolonged inflation had been documented as a negative predictor of recovery of spontaneous circulation (ROSC) and survival of out-of-hospital cardiac arrest (OHCA) patients. However, with the current recommendation of asynchronised chest compression and ventilation, ventilation might be disturbed by chest compression. We designed this observational study to clarify the influence of chest compression on ventilation.

Materials and methods: Twelve OHCA patients were resuscitated in a tertiary medical center in Taipei. A side stream capnometry and main stream capnography had been put on to the airway circuit after endotracheal (ET) intubation. Airway physiological parameters were recorded during resuscitation without any protocol interference. Every 1-minute duration of ventilation data in the 0, 5, and 10 min after ET insertion were retrieved. Respiratory rate, inspiration time, peak airway pressure, peak airway flow, inspiration volume and end-tidal carbon dioxide (ETCO2) concentration were recorded and analysed.

Results presented in sufficient detail to support the conclusions: A total of 458 breaths were observed, with most of them involving hyperventilation (377/425, 88.71%), prolonged inflation (297/458, 64.85%) and being of adequate volume (253/458, 63.97%). The adequate inflation time correlated to lower airway pressure (47.45 ± 17.23 vs. 58.62 ± 22.82, p = 0.002), higher flow rate (82.19 ± 25.02 vs. 70.33 ± 18.62, p = 0.001); higher peak airway pressure correlated to longer inflation time (r = 0.11, p = 0.018), larger inspiration volume (r = 0.205, p < 0.001), higher peak airway flow (r = 0.203, p < 0.001); longer inspiration time correlated to higher ETCO2 (r = 0.279, p < 0.001).

Conclusions: The current requirement of ventilation in resuscitation guidelines is hardly followed. To achieve higher ETCO2, we may need longer inspiration time. High peak airway pressure, which might correlate with chest compression, tends to induce longer inflation time and larger volume would probably need to be reduced.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.057

AP010

Tracheal intubation in patients during adult cardiopulmonary resuscitation: a comparison of the TrueView EVO2 PCD and Macintosh laryngoscopes

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Purpose of this study: The European Resuscitation Council guidelines consider endotracheal intubation (ETI) the gold standard for airway management. In addition, intubation – if the intubating person’s skills allow – should be performed without chest compression (CC) interruptions or with only a short break to introduce the endotracheal tube through the vocal cords. The aim of the study was to assess ETI efficacy during uninterrupted CC performed by novice physicians.

Materials and methods: The study was designed as a randomized crossover manikin trial and conducted between May and August 2015. It included 67 novice physicians. Before the trial, they participated in a 3-hour airway management training on airway anatomy, breathing physiology and pathophysiology, and different methods of airway management, including intubation with the Macintosh laryngoscope (MAC; Mercury Medical, Clearwater, FL, USA) and the TrueView EVO2 PCD (PCD; Truphatek Int.; Netanya, Israel) videolaryngoscope. During the training, participants practiced each intubation technique for 30 min to make sure they were familiar with the devices. To simulate a sudden cardiac arrest scenario, a SimMan 3G training manikin (Laerdal, Stavanger, Norway) was used, and the Lifeline ARM device (Defibtech, Guilford, CT, USA) was applied for CC. The participants had a maximum of 3 ETI attempts with each device.

Results: The time to first ventilation with the MAC and PCD varied and amounted to 26.8 (interquartile range [IQR] 24–32.5) seconds vs. 39.2 (IQR 33–45) seconds, respectively (p < .001). The first and overall intubation attempt success rates were significantly higher with the PCD compared with MAC (70.1% vs. 34.3%, p < .001; 94.0% vs. 86.6%, p = .025, respectively).
Conclusions: In a controlled uninterrupted CC scenario, the Tru-View EVO2 PCD offers better intubation conditions than MAC on an adult manikin among novice physicians. Further clinical studies are necessary to confirm these initial positive findings.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.058

AP011

The choice between cLMA and i-gel during CPR

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Purpose: Contemporary protocols suggest that the tracheal tube should generally be considered the optimal method of managing the airway during cardiac arrest; however, without adequate training and experience, the incidence of complications is unacceptably high. Several alternative airway devices have been equally recommended for airway management during CPR. There are no data supporting the routine use of any specific approach to airway management during cardiac arrest, and the best technique is dependent on the competence of the rescuer. In our study, we wanted to show which device – the classic laryngeal mask airway (cLMA) or the i-gel– is easier to insert without basic training.

Materials and method: We recruited 50 volunteer final-year medical students who had no advanced airway management experience. After a short oral presentation of the insertion technique, the students performed airway management with the two above-mentioned airway devices, on an airway management trainer from Laerdal. Data were collected on insertion success rate among the performers.

Results: In our study, the performers were young, 24.10 ± 1.44 years and mostly female [34 (68%) and 16 (32%) male]. Success rate at i-gel insertion at first attempt was 100%, whereas in cLMA placement, one female performed managed to insert the LMA only at the second attempt. The median “time to ventilation” was significantly shorter when i-gel was used (7 s vs. 10 s for classic LMA). Female performers needed a shorter time to insert the cLMA (median = 10; IQR: 8.6–12.8 s vs. median = 10.5; IQR: 8.5–12.0), but men were more skilled with i-gel (median = 7; IQR: 5.75–9.25 vs. median = 6.5; IQR: 6–8).

Conclusion: Supraglottic devices are easy to use for inexperienced personnel, and the i-gel is a device which needs a shorter time to successful insertion at first attempt, which is important for shorter “hands of time”.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.059

AP012

ETView SL® vs. McGrath® MAC for tracheal intubation by novice paramedics in simulated cardiopulmonary resuscitation: A randomized crossover cadaver study

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Purpose of the study: The European Resuscitation Council guidelines emphasize the need to minimize chest compression (CC) interruptions during cardiopulmonary resuscitation (CPR). It would, therefore, be desirable to perform endotracheal intubation (ETI) with uninterrupted CC. Our aim was to compare the time and success rate of ETI performed with ETView SL® (ETView; ETView Ltd., Missigav, Israel) vs. McGrath® MAC (MAC, Medtronic, Minneapolis, MN, USA) with two ETI methods by novice paramedics during simulated CPR on a cadaver model.

Materials and methods: The 27 paramedics participating in the randomized crossover study received a 10-min lecture on airway management and adequate use of the mentioned devices. They practiced intubation and placement, respectively, in a classically positioned Laerdal Airway Management Trainer (Laerdal, Stavanger, Norway), 5 min per device. Then they performed ETI on fresh adult cadavers in two scenarios: without (A) and with concomitant (B) CC. The time to and success of intubation with ETView and MAC in two different emergency conditions were assessed.

Results: In scenario A, the time to first ventilation was significantly shorter with ETView (19.7 [IQR, 17–22.5] s) than with MAC (23.5 [IQR, 21–28] s) (p = .003). In scenario B, the median time for intubation was 32.0 (IQR, 26–35.5) s for MAC, and 20.5 (IQR, 18–25.5) s for ETView (p < .001). The success rate of ETI after the first attempt varied between 92.6% and 100% (MAC and ETView) for scenario A and between 88.8% and 100%, respectively, for scenario B.

Conclusions: With a short training session, paramedics are able to perform ETI in cadavers with ETView and MAC laryngoscopes in a simulated cardiac arrest scenario. In case of ETI with the cadaver at rest, both devices facilitated ETI within seconds. In the scenario with ongoing CC, time needed to ETI was significantly longer with MAC than with ETView.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.060

AP013

Comparison of Pocket Mask vs. bag valve mask ventilation in cardiopulmonary resuscitation

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Purpose of the study: In sudden cardiac arrest, ventilation is an essential cardiopulmonary resuscitation (CPR) element. In the first CPR phase, the bag valve mask (BVM) remains the main ventilation method, especially if rescuers cannot perform endotracheal intubation or supraglottic airway devices are unavailable. The study aim was to compare ventilation effectiveness with BVM and with the Pocket Mask under simulated CPR.

Materials and methods: The randomized crossover manikin trial involved 43 nurses. Before the study, all participants underwent 10-minute training in breathing physiology and pathophysiology and different methods of CPR ventilation. The order of participants and ventilation methods were randomized. The participants performed ventilation during a 2-minute CPR cycle on a Resusci-Anne manikin (Laerdal, Stavanger, Norway) using the Pocket Mask or BVM. In both cases, the facemask had an air cuff. Chest compressions were provided by the Lifeline ARM mechanical chest compression device (Defibtech, Guilford, CT, USA), with a 30:2 ratio. The following parameters were assessed: average tidal volume, minute volume and the number of gastric insufflation.

Results: Among the participants, 36 (83.7%) were female, the median age equaled 32 (30.5–36) years, median work experience 8.5 (4.2–12) years. All declared BVM ventilation ability. The median ventilation volume in the BVM and Pocket Mask groups varied
and amounted to 0.3 L vs. 0.5 L, respectively ($p = .015$). The median minute volume was 1600 and 3100 mL, respectively ($p = .001$). As for the number of stomach ventilation, the Pocket Mask results were significantly better than those for BVM (4 vs. 0, respectively; $p < .001$).

**Conclusions:** The studied nurses performed Pocket Mask ventilation significantly more efficiently than BVM ventilation. Education on the correct BVM ventilation is necessary in various clinical settings.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.061

**AP014**

**Limited role of amiodarone in stable ventricular tachycardia**

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**Purpose:** To investigate whether amiodarone is effective in terminating stable ventricular tachycardia (VT) in the emergency department.

**Materials and methods:** This retrospective case study includes all patients with VT consulting the emergency department of a tertiary medical centre in Taiwan from 1st January 2011 to 31st December 2015. Those who presented with shock, myocardial ischemia/infarction, heart failure or syncope were categorized as unstable. All of the patients underwent standardized treatment according to tachycardia algorithm – that is, synchronized cardioversion for unstable VT and amiodarone for stable VT. The treatment failure rate was measured and analysed.

**Results:** Two hundred and thirty patients, including 209 (90%) unstable and 21 (10%) stable, were enrolled. Of unstable cases, 38 (18%) were complicated with myocardial infarction, 114 (55%) myocardial ischemia, and 57 (27%) long QTc. Successful electrical cardioversion was accomplished by single shock in 176 (84%), double shocks in 29 (14%) and three or more in 4 (2%). In contrast, only two patients (10%) with stable VT gained rhythm control by intravenous amiodarone, whereas 12 (57%) were successfully cardioverted by calcium channel blockers and 7 (33%) by adenosine. Of those for whom amiodarone failed, 19 (100%) were diagnosed as idiopathic VT by electrophysiological study.

**Conclusion:** Although updated resuscitation guidelines disclose that amiodarone is the drug of choice for stable VT, our data did not support this consensus. Those with significant coronary heart disease usually presented with unstable VT, whereas patients with stable VT were always idiopathic VT refractory to amiodarone. We suggest calcium channel blockers or adenosine should be considered when a first dose of amiodarone fails to terminate stable VT in the emergency department.1,2

**References**


http://dx.doi.org/10.1016/j.resuscitation.2016.07.062

**AP015**

**Amplitude spectrum area as a tool to estimate downtime of ventricular fibrillation**

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**Purpose:** Ventricular fibrillation (VF) cardiac arrest (CA) is characterized by three time-dependent phases: electrical (0–4 min), circulatory (5–10 min) and metabolic (>11 min). These phases reflect the progressive increase in myocardial ischemia and decrease in myocardial viability. Identification of the VF phase may facilitate appropriate CPR treatment. However, downtime is often unknown at EMS arrival. In the current study, we used AMSA to estimate downtime using a logarithmic function and verify its accuracy.

**Methods:** Our single-centre database of electrocardiographic defibrillator records collected between 2007 and 2013 includes 248 patients with bystander- or EMS-witnessed cardiac arrest and VF as the first recorded rhythm. We analysed a random sample of 108 records, excluding cases with missing data. AMSA was calculated in the first pre-shock pause, using 2-sec ECG. Downtime was calculated as the time difference between patient collapse and first responder arrival. If the collapse time was not available, the emergency call time minus 1 min was used instead.

**Results:** Downtime ranged between 1 and 25 (8.7 ± 3.9) min, with a corresponding AMSA between 1.25 and 20 (7.3 ± 3.4) mV-Hz. AMSA was 8.48 ± 3.34 mV-Hz in the electrical phase ($n = 10$, downtime of 2.7 ± 1.34 min), 8 ± 3.29 mV-Hz in the circulatory phase ($n = 73$, 7.7 ± 1.4 min) and 4.79 ± 2.31 mV-Hz in the metabolic phase ($n = 25$, 13.9 ± 3.7 min), respectively. AMSA measured in the circulatory phase was significantly higher than that in the metabolic phase ($p = 0.001$). Linear regression revealed that AMSA decreases by 0.34 mV-Hz for every minute of VF. A logarithmic equation [downtime = $-3.88 \times \ln$ (AMSA) + 15.96] to estimate downtime from AMSA had $R^2 = 0.24$ and accuracy of 76.5% ± 16.2% for circulatory and metabolic phases.

**Conclusions:** AMSA is associated with downtime in bystander-witnessed OHCA victims with initial rhythm of VF. AMSA could be useful to help estimate downtime for circulatory and metabolic phases.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.063

**AP016**

**Students’ attitudes towards BLS/AED training: Results from a survey of Sudan Resuscitation Council Courses participants**

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**Purpose of the study:** Modern medical educational programs include didactic lectures and mentored clinical teaching, together
with directed self-study. Safe medical practice builds on repetitions and routines. Introducing BLS/AED training, by imparting cognitive knowledge and psychomotor skills in university settings, has been a widely recommended long-term strategy to educate the wider scope of healthcare professionals towards ensuring standardized patient care. In our study, we aimed to assess the final-year medical and dental students' attitudes towards BLS/AED training.

**Materials and methods:** A total of 137 (60%) of 227 medical and 60 (77%) of 78 dental students, participants of BLS/AED courses in Khartoum, Sudan, completed an online survey. Median age of medical (73% female) and dental (95% female) students was 24 years (range 21–30). The survey consisted of demographic data, and 15 statements regarding BLS/AED training. The responses were Likert-type ranging, from 1 (strongly disagree) to 5 (strongly agree), where theoretical range of results was the score of minimum 15 (negative attitude), and maximum 75 points (positive attitude).

**Results:** Cronbach’s alpha of the whole scale was 0.72, indicating acceptable internal consistency. There was no difference in attitudes towards BLS/AED training between medical and dental students \( (P = 0.066) \), as well as between genders (median female 64 vs. male 63; \( P = 0.305 \)). The average score on the BLS/AED scale was 64 (5th percentile 55–95th percentile 72), indicating overall positive students’ attitudes towards BLS/AED training. Both, medical and dental students expressed the strongest agreement with stating that learning BLS/AED during undergraduate years was financially supported/encouraged by parents (17% vs. 14%). The least agreement was with the statement that BLS/AED training should commence already in secondary school (78% vs. 70%), while the least agreement was with the statement that learning BLS/AED during undergraduate years was mandatory (73% vs. 77%).

**Conclusions:** Our study demonstrated that medical and dental students have very positive attitudes towards BLS/AED, strongly supporting compulsory BLS/AED training throughout undergraduate studies.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.064

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**Table 1**

<table>
<thead>
<tr>
<th>Location</th>
<th>Number Cases</th>
<th>CPR performed by</th>
<th>AED applied by</th>
<th>Time to AED retrieval (min)</th>
<th>Time to AED Power-on from arrival at patient (min)</th>
<th>Time to fist shock from AED Power-on (min)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Bystander</td>
<td>AED Trained Employee</td>
<td>Bystander</td>
<td>AED Trained Employee</td>
<td>Bystander</td>
</tr>
<tr>
<td>Retail</td>
<td>89</td>
<td>43 (56%)</td>
<td>34 (44%)</td>
<td>28 (33%)</td>
<td>58 (67%)</td>
<td>3 (1, 5)</td>
</tr>
<tr>
<td>Hotel/Resort</td>
<td>61</td>
<td>10 (20%)</td>
<td>40 (80%)</td>
<td>5 (9%)</td>
<td>52 (91%)</td>
<td>2 (1, 4.5)</td>
</tr>
<tr>
<td>Business/Corporation</td>
<td>162</td>
<td>18 (14%)</td>
<td>111 (86%)</td>
<td>3 (2%)</td>
<td>144 (98%)</td>
<td>2 (1, 5)</td>
</tr>
<tr>
<td>Government Organization</td>
<td>50</td>
<td>9 (22%)</td>
<td>32 (78%)</td>
<td>1 (2%)</td>
<td>41 (98%)</td>
<td>2 (0.7)</td>
</tr>
<tr>
<td>Fitness Center</td>
<td>180</td>
<td>49 (33%)</td>
<td>99 (67%)</td>
<td>38 (23%)</td>
<td>126 (77%)</td>
<td>1 (0, 3)</td>
</tr>
<tr>
<td>Healthcare facility (Nursing home, hospice)</td>
<td>34</td>
<td>1 (3%)</td>
<td>28 (97%)</td>
<td>1 (3%)</td>
<td>31 (97%)</td>
<td>2 (0, 5)</td>
</tr>
</tbody>
</table>

\( P < 0.001 \) (excluded untrained AED employees/unknown from analysis since small sample); time reported as median (IQR).
Studies have shown that CPR and apply the AED. AED retrieval times are shortest in fitness centers compared to other locations.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.065

AP018

Resuscitation and physical exercise: Can a strength training program help to improve quality?

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Purpose: The quality of chest compressions is key to cardiopulmonary resuscitation (CPR). In case of out-of-hospital cardiac arrest, a long-duration CPR might be required. The aim of this study is to evaluate the effect of a muscular strength training program on CPR quality.

Material and methods: Ninety-eight subjects with CPR knowledge participated in the study. They were separated into three groups: Control (CG; 40), experimental 1 (EG-1: 35) and experimental 2 (EG-2: 23) groups. The three groups performed a CPR 10-min test (T1): compression:ventilation 30:2. Both EG-1 and EG-2 were trained with a muscular strength training program over 4 weeks (three sessions per week). EG-1 trained by themselves and EG-2 were supervised by a personal trainer. CG did not receive any training. At the end of the training period, all of them repeated the test (T2).

Results: When T1 and T2 results were compared, no significant differences in the chest compression percentages were found in CG (p = 0.781) and in EG-1 (p = 0.519). However, results were significantly better in T2 than in T1 in case of GE-2 (supervised training) (p < 0.001).

Conclusions: A supervised muscular training program improves quality of chest compressions and helps to maintain quality during a 10-min period. Providers with the duty to assist should be encouraged to train not only in CPR abilities but also in physical performance.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.066

AP019

Motivation, training–reality discrepancy and psychological influence among lay rescuers in Taiwan

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Purpose of the study: Bystander-initiated CPR and AED deployment is pivotal in community chain of survival, but little is known regarding why lay rescuers are motivated to help, gaps between what they have been told versus what they experienced, and the influence from the incidents. This qualitative study was conducted to explore factors related to motivation, training–reality discrepancy, and psychological influence among lay rescuers who had performed CPR and AED in public locations in Taiwan.

Materials and methods: Lay rescuers who had provided initial CPR and AED deployment public locations across Taiwan were recruited from the Taiwan Public AED Registry for a semi-structured, in-depth interview lasting 90 min, and included the following domains: 1) basic demographic information, 2) prior CPR and AED training, 3) factors related to motivation, 4) discrepancies between knowledge and skills acquired at prior training versus that encountered and required by actual events and 5) psychological influence from the incidents.

Results: Nine lay rescuers were recruited and completed the interview. The results showed that high motivation was observed among those with higher level of confidence and situational awareness, and with team atmosphere that reduced bystander effects. Lay rescuers reported certain aspects of rescue reality that differed much from prior training and expectations, such as appearance of agonizing respirations, texture of human body versus mannequin, and force needed to compress the chest. Post-event flashbacks were common, but the influence could be positive when experience was shared, or positive feedback provided by professional providers.

Conclusion: This study provides valuable information on strategies to increase layperson CPR rates and CPR training effectiveness. Measures should be taken to increase layperson confidence and situational awareness, to reduce training–reality discrepancy and to foster positive psychological influence.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.067

AP020

Effectiveness of resuscitation courses provided by Bjargráturn (Icelandic medical students resuscitation association.) during the years 2013–2016: A cross-sectional study

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Purpose: The purpose of this study was to evaluate the effectiveness of short (60–80 min) resuscitation courses provided by medical student volunteers to students aged 15–19. We also aimed to evaluate the decline in knowledge retention over a 2-year period.
Materials and methods: 1513 students split into four groups in two Reykjavik high schools were tested on their knowledge in resuscitation. One group before the course, another 4 months after the course, a third 1 year later and the fourth 2 years later. A questionnaire comprising 15 multiple-choice questions, designed by the study author based on ILCOR 2010 guidelines, was used to evaluate the student’s knowledge in resuscitation. Students were also asked about earlier resuscitation courses and attitude towards resuscitation. Grading was based on questions 1–13. A passing grade was assigned with 7 out of 13 or more correct answers.

Results: 1218 (80.5%) students completed the questionnaire; 46.6% of students had attended another resuscitation course previously. Before the course, the proportion of students who passed was higher in the subgroup that had previously attended a resuscitation course (45.5%) versus the subgroup that did not (30.0%). Four months after the course, 80.0% of students passed regardless of previous resuscitation courses. Over 2 years, the proportion of students that passed dropped by 16.4% in the subgroups that had not attended another resuscitation course versus 4.5% in the subgroups that had attended Bjaragrúður’s course and another course.

Retention of resuscitation knowledge in students aged 15–19 is improved with additional resuscitation courses. Students with higher marks were more likely to start compressions and use AEDs.

Conclusions: Short courses in resuscitation provided by volunteers are effective in increasing knowledge in resuscitation in students aged 15–19.

Retention of resuscitation knowledge in students aged 15–19 is improved with additional resuscitation courses. Students with higher marks were more likely to start compressions and use AEDs.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.068

AP021

Do people who graduate from a first-aid course have actual knowledge of providing first aid?

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Purpose of the study: Basic life support consists of cardiopulmonary resuscitation (CPR) and, when available, defibrillation with automated external defibrillators (AED). Keys to survival from sudden cardiac arrest are early recognition and treatment, specifically immediate initiation of effective CPR and early defibrillation. Self-possession and composure during emergency treatment can only be achieved through competent theoretical and practical training. The aim of this paper is to compare the level of first aid (FA) knowledge among young people (16–19 years old) after the FA course (80) and without it (277).

Materials and methods: Three hundred and fifty seven young inhabitants of Lublin Voivodeship, Poland, took part in the research. A questionnaire including 23 questions was used as a research instrument. Participation in the research was voluntary and anonymous.

Results: Twenty two per cent of the interviewers answered that they participated in FA courses; 30% gained information about providing first aid from the European Resuscitation Council guidelines. The rest of the respondents gained this knowledge from non-expert sources such as the Internet, friends and magazines; 94.9% of the young people after the FA course and 95% of the people without the course realised the ratio of chest compressions to ventilations. Moreover, 56.2% of the young people after course and 51.8% of the people without the FA course knew the place where the chest compression should be performed.

Conclusions: The level of FA knowledge in the research group was slightly better in a group of young people after a first aid course. Unfortunately, the general knowledge of FA is unsatisfactory. The reason for this condition is the false conviction that knowledge once gained does not require practice and updating.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.069

AP022

Knowledge and skills of high school students in Surgut (Russia) in setting of BLS modern algorithms

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Background: Increasing of competency level of high school students in Surgut in accordance with BLS modern algorithms.

Materials and methods: Research was conducted in 2015–2016 academic years within the volunteer project “Children of JUGRY for saving life” with participation of students and teachers of “The Surgut state pedagogical university”. This study included 204 high school students 16–17 years old from several schools in Surgut. At first, students were asked to assess their BLS knowledge and skills using a questionnaire developed by the authors. On the basis of the received data, a group of students (n = 44) who reported BLS capability were selected. Then, the next step was to assess their BLS practical skills on a manikin using the method of providers ERC (2010). Next, the students completed the training course according to modern algorithms BLS (provided by ERC recommendations, 2015).

Results: The questionnaire shows 94.7% (n = 156) of students knew about BLS. Of these, 41.7% (n = 65) knew about the modern algorithm of BLS; 21.6% (n = 44) responded that they are able to perform BLS; and 10.8% (n = 22) reported prior experience performing BLS. The assessment of BLS performance on a manikin using the method of providers ERC (2010) among the group of the students who answered they are able to undertake BLS (n = 44) showed that no one demonstrated BLS skills. The training course has allowed to educate the high school students about BLS modern algorithms (the recommendations of ERC, 2015).

Conclusion: This investigation showed extremely poor knowledge of BLS modern algorithms among high school students in Surgut. Wide popularization of knowledge and practical training using modern requirements allow formation of a reliable level of competence.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.070

AP023

Knowledge and attitudes concerning cardiopulmonary resuscitation among dentists in Poland

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Purpose of the study: Dental adult patients, receiving local anesthesia and/or pharmacological sedation, are at risk of respiratory failure/apnea and sudden cardiac arrest (SCA). Our purpose was to assess the Polish dentists’ general knowledge
about cardiopulmonary resuscitation (CPR), and to determine their attitudes towards intraosseous (IO) access during CPR.

Materials and methods: A descriptive, comparative cross-sectional study using an anonymous survey was conducted among Polish dentists in 2016. The questionnaire referred to CPR general knowledge and skills. Out of the 200 dentists invited, 115 returned the questionnaires.

Results: Most of responders (89.6%) were female; the mean age was 41.8 ± 10.9 years, and mean work experience was 15.9 ± 10.7 years. Only 18.3% of participants had attended a CPR training within the past 12 months, 46.9% within 2–5 years, and 28.7% within 6–10 years; 6.1% did not participate in any CPR training. Among SCA signs, 47.8% of respondents indicated lack of breath, 33% – gasping, 26.1% – slow, abnormal breathing, 16.5% – quiet snoring, 6.9% – loud snoring; and 10.4% considered none of the above an SCA symptom. Only 20% stated their ability to obtain venous access in an SCA patient, and 10.4% would use IO drug administration if a special device was accessible. As for CPR performance, 40.8% would always lay the patient down on the floor, 48.7% would leave them on the dental chair, arranging it to the horizontal position; and for 10.4% of dentists both CPR techniques were correct.

Conclusions: The Polish dentists’ general knowledge on CPR guidelines is poor. It seems necessary to introduce requirements for dentists to regularly participate in CPR courses. Moreover, dentists should receive training in emergency intravascular access (intra-venous and IO).

http://dx.doi.org/10.1016/j.resuscitation.2016.07.071

AP024

Availability of emergency medical equipment in dental offices in Poland: A preliminary study

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Purpose of the study: The 2015 European Resuscitation Council guidelines suggests national guidelines for recommended equipment in case of medical emergencies in dental practice. The aim of the study was to evaluate the availability of emergency medical equipment in dental offices in Poland, and factors affecting equipment availability.

Materials and methods: A link to an online, previously validated questionnaire was emailed to 200 dentists in Poland. It contained questions about the possessed equipment essential for resuscitation, about applying pharmacological sedation during medical procedures, and about the prevalence of medical emergencies within the last 12 months.

Results: The study involved 115 dentists; 86.1% declared the usage of pharmacological sedation in their professional practice (including nitrous oxide). Among all study participants, 18.3% claimed to possess an automated external defibrillator (AED), 26.9% – a source of oxygen and 37.4% – supraglottic airway devices (SADs).

Regression analysis showed a correlation between the number of medical emergency cases in a dental office requiring an emergency medical system call – and possessing SADs (r = 0.31; p = 0.015). The correlation was not observed for possessing an AED or oxygen source.

Conclusions: The medical emergency equipment available in dental practices in Poland is improving. Increasingly, dental offices are equipped in accordance with the European Resuscitation Council guidelines.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.072

AP025

CPR: Hands-only and AED Training Concept for 12-year-old children in primary schools in Luxembourg

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The purpose of the study was to create a CPR Training Concept for 12-year-olds in primary schools in Luxembourg. Selected teachers without any prior knowledge in CPR took part in a 2-hour training session. They were chosen as qualified to instruct 12-year-olds in hands-only-CPR and use of an AED.

To survey the effectivity of our concept, 49 children were tested on their theoretical knowledge and their practical skills. We worked out a scripted case study, made a recording video and a checklist with Ambu CPR™ software. In addition, interviews of the teachers completed our testing.

Due to physical condition of the children, the compression depth was not taken into consideration for the evaluation of a successful hands-only-CPR. Results showed a rise in the number of correct answers from QCM, scaling from 28% at the beginning to 74% at the end. From three classes tested in hands-only-CPR, the case study has shown that two classes reached a success rate of 62% versus 75%. Nevertheless, one class showed a failure rate of 87%. In that specific case, we realised that one teacher did not respect our training scheme, expanding instruction unit with additional unnecessary details (e.g., pulse taking, recovery position) and, therefore, the hands-only-CPR training period got shorter.

The success rates whilst using the AED were 87% in two classes and 76% in the third class.

In conclusion, the training concept was mostly successful. Prior knowledge, whilst being an advantage, is not a necessity. Teachers without any previous experience of CPR with our short training session were successful and able to instruct their children in hands-only CPR and use of an AED. For future trainings, minor adjustments of our training concept are necessary. As for teachers, it is important to strictly adhere to the curriculum.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.073

AP026

Looking back at 8 years of teaching CPR with MiniAnne™ at the “Athénée of Luxembourg”

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The “Athénée of Luxembourg” (AL) is the first secondary school in Luxembourg to teach regularly CPR skills. Because of its importance in CPR teaching in the country, the AL wants to present a review of 8 years.

The initial concept has proved to be pedagogically sound, as this current study is going to lay out.

More than 90% of all students feel confident that they do have appropriate skills for CPR in case of emergency. Since 2009, students from grades 8, 10 and 12 have been successfully trained to use CPR skills as First Responder. In addition, members from our teaching and non-teaching staff regularly attend professional development classes in this field. This amounts to a total of 4500 students and adults at the AL who have been trained and updated in CPR skills efficiently. Thus, CPR has become an integral part of student life. Indeed, one of the main tasks of the AL First Aid Team
(EHTK) consists in setting up and running CPR training courses throughout the school year.1

In addition, the EHTK has regularly put a lot of effort into promoting CPR awareness among the larger public since 2010. The First Aid Team is also regularly called upon by Luxembourg Primary Schools or other Secondary Schools to offer CPR training courses.

Luxembourg Resuscitation Council has been actively supporting this project since 2009. It draws from previous experiences at the AL in order to motivate other secondary schools to offer CPR courses. Sixteen students (13 AL, 3 LGL) were called upon by the ING-Night-Marathon organisational committee to act as First Responders during the running competition on 28 May 2016.

References
2. AL First Aid Team – www.ehtk.lu.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.074

AP027

Social representations of Basics Life Support

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Victims of cardiac arrest need immediate Basic Life Support in order to preserve, as much as possible, the flow of blood to the brain and heart and other vital organs. It is essential to gain time pending differentiated help, performing simple and practical (BLS) acts to save lives. Learning how to perform CPR is an interactive process that requires knowledge and skills, but is, simultaneously, an act of solidarity, social responsibility, civic consciousness and a duty of citizenship. Because no one revives alone, it requires the coordinated work of a team; all citizens must join forces in a single goal: Save Lives, through the massification of the BLS.1

We conducted an exploratory study that aimed to identify social representations of BLS in the general population. We used the technique of free association of words through a short questionnaire, and obtained a sample of 45 participants.

The results show that participants were mostly female and 27, with age trend in the age group of 40 to 59 years. With regard to social representations, we find an organized structure follows the core: help, help to revive, and save is giving life are, in fact, structural and consensual elements in BLS. Towards peripheral elements, we find extremely important elements that can be worked in a way such that the core is more efficient, such as to act in coordination as a team when faced with an accident, and can, thus, be successful in practice. The social representation of BLS does not differ from that referred in the literature on the subject, but it is common knowledge that these skills can only be acquired if they are systematically trained, because they obey an algorithm that, if it not settled theoretically and instrumentally, is not effective in practice.2

References

http://dx.doi.org/10.1016/j.resuscitation.2016.07.075

AP028

Comparative study of CPR knowledge level in two public Greek hospitals

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Purpose: The purpose of this study is to compare the cardiopulmonary resuscitation (CPR) knowledge level of the staff of two public Greek hospitals.

Materials and methods: The participants (n = 203) are from the Evangelismos General Hospital (E.G.H) (n = 101) and the Kavala General Hospital (K.G.H) (n = 102). Data collection was performed with a questionnaire that included questions, open, closed-ended and multiple choice, addressed to the hospital staff. In the total sample, 28.6% are men (25.7% in K.G.N. and 31.4% in E.G.H.) and 71.4% are women (74.3% in K.G.H and 68.6% in E.G.H.). The statistical analysis was done with the statistical package SPSS Statistics 17.0.

Results: In total (203), from the two hospitals, 77.8% of the participants attended CPR courses (80.1% in K.G.H. and 75.5% in E.G.H., p = 0.419). More women (79.3%) than men (74.1%), attended courses (p = 0.423), as did more doctors (86%) than nurses (81.4%), (p = 0.168).

Among the participants who attended CPR courses, 69–80% knew correctly the essential manipulations of CPR.

Conclusions: The majority of the participants attended CPR courses and no statistical difference was found between the two hospitals. Doctors and women were found to be more educated in CPR, but this was not statistically significant.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.076

AP029

Effect of intrathoracic pressure on diastolic function of the heart during cardiopulmonary resuscitation in an animal model of cardiac arrest

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Purpose: Details of the mechanism of diastolic filling of the ventricle during cardiopulmonary resuscitation (CPR) remain unknown. This study aimed to investigate the effect of intrathoracic pressure (ITP) on diastolic filling of the heart during CPR.

Material and methods: In 10 male pigs (body weight: 39.6 ± 8.5 kg), catheters were inserted to measure hemodynamic parameters and chest tubes were inserted bilaterally to manipulate the ITP. After 2 min of ventricular fibrillation, the animals received manual CPR with both chest tubes clamped (C-CPR) for
3 min and manual CPR with both chest tubes opened (O-CPR) for 3 min, alternatively. The sequence of CPR was performed alternatively according to the randomization schedule.

**Results:** No significant differences were observed in the maximal dp/dt of LV (O-CPR: 674 ± 508 mmHg/s vs. C-CPR: 687 ± 558 mmHg/s, \(p = 0.808\)), maximal dp/dt of LV (O-CPR: −615 ± 316 mmHg/s vs. C-CPR: −611 ± 325 mmHg/s, \(p = 0.065\)), dp/dt of LV upslope (O-CPR: 2634 ± 1250 mmHg/s² vs. C-CPR: 2614 ± 1307 mmHg/s², \(p = 0.947\)), and dp/dt of LV downslope (O-CPR: −6111 ± 3204 mmHg/s² vs. C-CPR: −6243 ± 3407 mmHg/s², \(p = 0.389\)). No significant differences were observed in the maximal dp/dt of RV (O-CPR: 659 ± 545 mmHg/s vs. C-CPR: 698 ± 595 mmHg/s, \(p = 0.162\)), maximal dp/dt of RV (O-CPR: −582 ± 370 mmHg/s vs. C-CPR: −603 ± 382 mmHg/s, \(p = 0.313\)), dp/dt of RV upslope (O-CPR: 2600 ± 1656 mmHg/s² vs. C-CPR: 2631 ± 1656 mmHg/s², \(p = 0.757\)) and dp/dt of RV downslope (O-CPR: −5793 ± 3807 mmHg/s² vs. C-CPR: −6241 ± 4117 mmHg/s², \(p = 0.044\)).

**Conclusions:** ITP does not affect the diastolic filling rate of the ventricles during standard CPR.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.077

**AP030**

**Randomized comparison of two-thumb vs. two-finger chest compression during infant resuscitation performed by paramedics**

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**Purpose of the study:** Quality chest compression (CC) is crucial in both pediatric and adult resuscitation. This study aimed to evaluate the quality of CCs when performed by paramedics in a newborn by means of two recommended techniques.

**Materials and methods:** In a randomized crossover manikin study, 45 paramedics provided 2-minute infant resuscitation using the two-finger and two-thumb techniques. The Resusci Baby QCPR manikin (Laerdal, Stavanger, Norway) was used. Before the study, all participants received a 20-minute training on infant resuscitation according to the 2015 ERC guidelines. We assessed the median CC rate, percentage of adequate rate CCs (100–120 per minute), hand-position correctness, fully released CCs, compression depth and the rescitators' preferences.

**Results:** With the two-thumb and two-finger technique, the median CC rate was 134 (interquartile range [IQR], 126–145) min⁻¹ vs. 126 (IQR, 118–130) min⁻¹, respectively (\(p = 0.013\)). The two-thumb technique allowed better CC parameters than the two-finger technique with regard to the adequate rate CCs percentage (21 [IQR, 18–25]% vs. 11 [IQR, 8–13]%, respectively; \(p < 0.001\) and the deep enough compressions percentage (83 [IQR, 80–91]% vs. 6 [IQR, 2–8]%, respectively; \(p < 0.001\)). However, more fully released CCs were obtained in the two-finger group (52 [IQR, 43–56]% vs. 26 [IQR, 23–33]%; \(p < 0.001\)). Hand-position correctness was similar in both groups and equalled 99% [IQR, 97–100%] for the two-finger and 99% [IQR, 98–100%] for the two-thumb technique (\(p = 0.84\)). There were no differences regarding CC technique preferences among the participants (\(p = 0.069\)).

**Conclusions:** In a simulation setting in an infant manikin, the two-thumb technique allowed higher quality CCs by paramedics. They need additional training to optimize CC quality, namely, on full chest relaxation.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.078

**AP032**

**Rescuer body mass composition and chest compression quality in Basic Life Support**

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**Purpose:** Quality of chest compressions is a determinant factor in the success of the resuscitation process. This quality includes...
items such as compression rhythm, compression depth, chest complete release and hand position. Training is important for high performance of the rescuer. But is it the only factor? This study aimed to evaluate the influence of rescuers’ body mass composition in the quality of chest compressions.

**Materials and methods:** An observational study conducted after 18-hour training in the Emergency Nursing curricular unit (graduation nursing course, Nursing School of Coimbra, Portugal), following which students were invited to perform 6 min of basic life support. Laerdal Nursing Anne with Skill Report was used to the basic life support and record the students’ performance. To access body mass composition, “Omron Body Composition Monitor (BF 500)” was used. The students’ participation was voluntary and all data were collected anonymously.

**Results:** Fifty-four students participated in the research, 16 men and 38 women, but one woman could not complete the 6 min of basic life support because she felt early exhaustion. Age varies between 20 and 27 years (mean and median: 22 years). No differences in performance were associated with gender. We found significant statistical correlations between some items of body mass composition (Body Mass Index and Fat Visceral Mass) and some items of chest compressions quality (Percentage of Chest Compressions in a Wrong Place; Percentage of Chest Compressions without complete release). These correlations show better quality of chest compressions in thin or normal weight people.

**Conclusions:** Body mass composition could be an important variable in the performance of chest compressions, probably associated with increased difficulty of breathing and control of breathing in obese persons. More studies could contribute to identify the need of different training modalities, adjusted to the different rescuer characteristics.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.080

**AP034**

**Chest compression quality among medical students after basic life support courses in a traditional medical curriculum**

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**Purpose of the study:** Chest compression quality is of utmost importance for successful resuscitation attempts. Accordingly, most undergraduate curricula strongly emphasize training these skills. As the performance of postgraduate physicians often does not meet guideline standards, we evaluated how efficient the teaching efforts are in a traditional medical curriculum.

**Materials and methods:** We examined chest compression quality (according to ILCOR 2010 guidelines – 5.0–6.0 cm compression depth, 100–120 compressions per minute and minimal leaning between compressions <5 mm) in 128 students directly after completion of the resuscitation training in the traditional curriculum of Charité – Medical University Berlin. The training consists of three installments in years 3, 4 and 5, 61 h in total. At the end, students performed compression-only-CPR for 5 min on a manikin and performance was recorded via Laerdal SkillReporter.

**Results:** Mean compression depth was 38.8 [37.4–40.3 SD] mm. Average rate over 5 min was 120.4 [118.0–122.7 SD] bpm. Of 72,804 compressions, only 40.3% were within target rate and 13.6% within target depth. Only 17.4% of participants maintained a medium leaning depth <5 mm.

**Conclusions:** Chest compression quality did not meet guideline targets at the end of an undergraduate curriculum. Leaning depth was only acceptable in 17.4% and could, therefore, be identified as a future focus of teaching BLS. Taken together, the decay of skills seen at the postgraduate level may already be attributed to insufficient teaching during the undergraduate phase.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.082
Automated external defibrillation skills performed by individuals with Down syndrome

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Purpose: Previous incidences have shown that individuals with Down syndrome (DS) are capable of performing chest compressions to a similar ability as an able-bodied individual. The purpose of this study was to assess the effectiveness of a brief training program involving an automated external defibrillator (AED) in training offered to individuals with DS.

Material and methods: Twenty-seven individuals with DS (20–43 years old) and 12 occupational therapists (OT; 22–60 years old) participated in a brief training session consisting of a five-minute demonstration of AED use. After instruction, participants individually performed a practical test in a manikin. Performance was evaluated by means of a checklist. Time to perform the procedure and any errors were recorded.

Results: Seventeen of 27 individuals with DS accomplished the defibrillation objective, that compares with all the OT subjects (p = 0.014). Individuals with DS achieved the objective in 74 ± 15 s, which compares with 50 ± 8 s in the OT group (p < 0.001).

Conclusions: After this brief training, more than half of the individuals with DS were able to correctly use an AED device in less than 2 min. This shows AED is user friendly and this training should be offered not only to able-bodied individuals but also to the handicapped allowing equal opportunities and social integration.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.083

Quality of Danish CPR courses for laypersons

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Purpose: The quality of bystander cardiopulmonary resuscitation (CPR) is likely affected by the quality of Basic Life Support (BLS) courses. The purpose of this study was to investigate the quality and adherence to international guidelines in Danish BLS courses.

Method: Based on previous models and predictors for survival from out-of-hospital cardiac arrest, a course evaluation sheet was developed and tested. It included 23 elements on a 5-point Likert scale. Nine essential elements associated with survival were identified as essential for good quality CPR before the collection of data. The result of the markings was tested with Fisher’s exact test to examine whether the distribution of the score was significantly different among three factors believed to influence the quality.

Results: A total of 56 course observations were conducted among ten of the largest national BLS providers. Of the observed courses with an announced duration of 3–4 h, 36% had less than 1 h of practical training.

We identified three factors associated with quality of the course on nine essential elements: instructor background, participant/instructor ratio, and the structure of the course. These factors all significantly influenced the distribution of the Likert scale scores: scores within: agonal breathing, 1–1–2 calls, compression depth and rate, ventilations, and use of AED. Courses with instructors with a healthcare background and participants/instructor ratio under 7 and those following the ERC structure scored significantly higher on all of the abovementioned items. The structure of the course also significantly influenced whether dispatch CPR was addressed. Non-ERC courses address this subject more than ERC courses.

Conclusion: The variation in adherence to international guidelines, content, and quality has been documented in Danish BLS courses and significant deviation from guidelines have been identified; this can be used to improve future BLS courses in the future.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.084
Chest compressions performance of emergency medical technicians in Japan before and after 2015 CoSTR statement

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Background: Adequate chest compression (CC) depth is critical for effective cardiopulmonary resuscitation (CPR). Although previous recommendations regarding compression depth have been at least 5 cm, the statement of Consensus on Science and Treatment Recommendations (CoSTR) 2015 proposed a lower threshold of 5 cm and an upper threshold of chest compression of 6 cm. Adherence to both upper and lower thresholds is challenging.

Objective: The study aimed to determine whether emergency medical technicians (EMTs) in Japan are performing adequate CCs in accordance with the CoSTR statement.

Methods: We assessed the quality of CCs performed by EMTs in 2013 and another group in 2015. EMTs received a lecture on the most current recommendations during training (the CoSTR 2010 statement or the CoSTR 2015 statement, respectively). All EMTs performed CCs for one minute on the same manikin without any real-time feedback during the CC. We measured CC depth, CC rate and the proportion of complete chest wall recoil in both groups.

Results: Thirty-five EMTs were assessed in 2013 and another 35 were assessed in 2015. CC quality was significantly altered in the 2015 group; CC depth (mean ± SD, 6.98 ± 0.59 cm vs. 6.06 ± 0.87 cm in 2013 and 2015 groups, respectively; p < 0.001), CC rate (mean ± SD, 118.62 ± 5.96 vs. 103.42 ± 6.94 bpm; p < 0.001) and the proportion of complete chest wall recoil (mean ± SD, 70.26% ± 35.19% vs. 92.96% ± 17.05%; p < 0.001) were all changed. There was better adherence to the guidelines in the 2015 group.

Conclusion: We observed that EMTs in Japan were able to perform CCs with adequate quality based on the statement of the CoSTR 2015 after a short teaching session. Furthermore, chest wall recoil may be improved when CCs are performed according to the guidelines specified in the CoSTR 2015 statement.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.085

Does TrueCPR applied during resuscitation training improve the quality of chest compressions at a later stage?

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Purpose of the study: Only good-quality chest compressions (CC) determine the effectiveness of cardiopulmonary resuscitation (CPR). As has been shown in many studies, the manual CC quality among medical staff is largely incompatible with the European Resuscitation Council (ERC) guidelines. The aim of the study was to determine the usefulness of TrueCPR (Laerdal, Stavanger; Norway) CPR feedback device in CPR training.

Materials and methods: The study was conducted in a group of 84 final-year medical students. At the beginning, all study participants attended a standardized basic life support course consistent with the ERC 2015 guidelines. Then they were divided into two groups, and performed 2-min CCs based on their own intuition. The first study group learned conducting CCs based on an instructor’s comments, the other with a TrueCPR device. After a month, for an evaluation of the quality of CCs performed by the study participants, they performed a 2-min asynchronous CPR. We analysed the following parameters: compression depth, compression ratio, correct hand position, and correct decompression.

Results: At baseline, there were no statistically significant differences between groups for any analysed parameters. During the re-evaluation, statistically significant differences occurred between the TrueCPR and manual groups with reference to: compression depth (50 [48–53] vs. 42 [38–47] mm; p < .001), compression ratio (118 vs. 136 CCs per minute; p = .011), and correct decompressions (66% [60–74%] vs. 46% [42–51%]; p < .001). There were no statistically significant differences concerning correct hand position (84% [82–87%] vs. 81% [78–86%]; p = .032).

Conclusions: The use of a CPR feedback device in CPR training significantly improves the CC quality in the later period.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.086
Conclusions: Primary school children are able to learn theoretical basics of cardiopulmonary resuscitation. The ability to perform effective chest compressions and ventilation depended on children’s age, weight, height, and BMI. Effectiveness of some parts of the cardiopulmonary resuscitation algorithm (chest compressions rate, correct hand position) was similar at all ages.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.087

AP040

A supraglottic airway is not sufficient for out-of-hospital cardiac arrest patients: An observational study

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Purpose of the study: Supraglottic airway (SGA) had been widely used in the resuscitation setting. However, advantages or disadvantages between SGA and the endotracheal tube (ETT) remain in debate. We recorded the physiological parameters during resuscitation and analysed the difference between SGA and ETT.

Materials and methods: Out-of-hospital cardiac arrest (OHCA) patients with prehospital laryngeal mask airway (LMA) insertion sent to a tertiary medical centre in Taipei had been put on a flowmetry and capnography to measure airway physiological parameters during resuscitation. The same parameters were also recorded after LMA changed to ETT during resuscitation in the hospital. All LMA functions had been confirmed by auscultation and capnography by physicians in the emergency department. Five breaths before LMA removal and 1 min after ETT intubation were analysed.

Peak airway pressure, peak inspiration flow, inspiration volume, expiration volume, peak carbon dioxide (CO2) concentration and end-tidal CO2 concentration were recorded and analysed.

Results presented in sufficient detail to support the conclusions: Airway parameters of ten OHCA patients were recorded both in the LMA and ETT settings. The result showed the LMA group had lower peak airway pressure (44.05 ± 17.041 vs. 57.88 ± 20.622, p < 0.001), larger inspiration volume (725.84 ± 627.407 vs. 468.67 ± 147.842, p = 0.006), and lower expiration volume (251.041 ± 234.4942 vs. 403.798 ± 236.9127, p = 0.002). As SGA does not perfectly seal the airway, air leakage during positive airway ventilation and concurrent chest compression is significant.

Conclusions: As an alternative advanced airway, SGA had more air leakage in current asynchronised chest compression and ventilation, which may compromise the ventilation effect during resuscitation.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.088

AP041

Nursing staff’s theoretical knowledge of cardiovascular resuscitation in Greece

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Purpose: Effective provision of cardiopulmonary resuscitation (CPR) increases patient survival and reduces in-hospital mortality. Nursing staff, as frontline healthcare professionals, are often those first present at cardiovascular arrests and respond by providing CPR. Their training has an impact on the efficiency of CPR and, consequently, on health outcomes. The aim of this study is the assessment of their status in providing useful information for decision making.

Methods: A cross-sectional study was undertaken in an NHS hospital in Greece to assess the theoretical knowledge of nurses and assistant nurses in relation to CPR. The study population surveyed consisted of nurses and assistant nurses of a specific public hospital.

Results: The study revealed that nursing staff had poor theoretical knowledge, with a mean score for correct answers in the written test of 50.6% ± 25.9% and a mean 4.1 ± 2 correct answers. Fifty-three percent of participants reported participating in a refresher course after attending a first course, whereas only 13.2% had participated in a relevant training program during the last 6 months prior to the study. Registered nurses who possessed a university (p = 0.016) or a technological institution (p < 0.001) diploma achieved 36.1% and 20.9% higher mean scores, respectively, in the written test in comparison to assistant nurses. The vast majority (91.9%) of the participants expressed their willingness to participate in CPR training courses.

Conclusions: It is crucial for nursing staff to participate in CPR courses in order to refresh and update their theoretical knowledge and performance skills and, consequently, to improve the safety and effectiveness of care.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.089

AP042

Performance of chest compressions with the use of a real-time visual feedback device: manikin study in healthcare professionals

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Purpose: Optimal chest compressions (CC) are a determinant factor in the success of cardiopulmonary resuscitation (CPR). However, providing CC with adequate rate and depth is difficult even among healthcare professionals. The aim of our study was to evaluate the impact of a real-time visual feedback device on the compression rate and depth.

Material and methods: Thirty-two healthcare professionals (nurses and physicians) of an intensive cardiac care unit performed CC on an adult manikin (Simulaid®). A sensor was placed between the rescuer’s hands and the manikin’s chest and was connected to a monitor/defibrillator (Zoll R Series®) which provided real-time visual feedback on rate and depth of compressions. Each participant performed 5 cycles of 30 CC without (OFF) and with (ON) visual feedback. Optimal CC was defined as compressions within the recommended range of depth (50–60 mm) and rate (100–120 cpm).

http://dx.doi.org/10.1016/j.resuscitation.2016.07.088
### Table 1
Performance of chest compressions without (OFF) and with (ON) visual feedback.

<table>
<thead>
<tr>
<th>Feedback</th>
<th>OPTIMAL CHEST COMPR. (%)</th>
<th>MEAN DEPTH (cm)</th>
<th>DEPTH IN TARGET (%)</th>
<th>MEAN RATE OF COMPR. (PER MINUTES)</th>
<th>RATE OF COMPR. IN TARGET (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>OFF</td>
<td>15.5 ± 24.4</td>
<td>5.1 ± 1.2</td>
<td>28.7 ± 35.7</td>
<td>115.9 ± 14.0</td>
<td>45.6 ± 35.0</td>
</tr>
<tr>
<td>ON</td>
<td>35.3 ± 32.0</td>
<td>6.6 ± 0.8</td>
<td>54.1 ± 63.3</td>
<td>110.2 ± 7.9</td>
<td>60.7 ± 32.0</td>
</tr>
</tbody>
</table>

P value: 0.001

### Results
The results are summarized in Table 1. The use of visual feedback resulted in a significant increase in the proportion of CC with depth in target (28.7 ± 35.7% OFF vs. 54.1 ± 63.3% ON, p < 0.001) and with rate in target (45.6 ± 35.0% OFF vs. 60.7 ± 32.0 ON, p < 0.039). There was also an increase in the proportion of optimal CC from 15.5 ± 24.4 OFF to 35.3 ± 32.0% ON, p = 0.001.

### Conclusions
The initial proportion of optimal CC was low (approximately 15%) and there was a basal (OFF) tendency towards lower depth and higher rate of CC. The introduction of the feedback technology (ON) significantly improved the quality of CC. The use of these devices in clinical practice might improve CPR success.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.090

### AP043
**A new paradigm on CPR quality: Omnisicenzs experience**

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**Introduction:** Chest compressions delivered at an adequate depth and rate are key to improve survival from cardiac arrest. However, delivering adequate chest compressions is difficult, even among well-trained rescuers. The use of real-time CPR feedback devices has contributed to improve the quality of CPR but, in most of the cases, is restricted to trained rescuers with previous knowledge; therefore, overall results are still suboptimal.

**Material and methods:** For clinical and educational purposes, we developed a wearable device specifically for CPR feedback that allows everybody trained and untrained to perform BLS according to current recommendations.

To analyze the accuracy of our mathematical model, we analyzed 4897 pulsations performed in a mannequin to rates of 80, 100, and 120 per minute and compared to a gold standard photometric distance sensor to achieve the accuracy of our method.

**Results:** The results were excellent with a root mean square error of 2.03, 1.83, and 1.32 mm, respectively, for each group with a Rho correlation of 0.89 p < 0.0001 compared to real distance sensor.

**Conclusions:** Quality in BLS is a key step to improve overall survival results, but in vivo studies are required to show real performance and impact on survival of our wearable device.1,3

### References

http://dx.doi.org/10.1016/j.resuscitation.2016.07.091

### AP044
**Surviving after ECPR: A retrospective observational study in a tertiary care center**

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**Objective:** Extracorporeal cardiopulmonary resuscitation (ECPR) has been reported to improve survival rate and neurological outcome in refractory CA (cardiac arrest). The purpose of this study is to report our experience with ECPR, in particular, the survival rate and neurological outcome [defined by a cerebral performance categories scale (CPC-scale) of one to two].

**Design:** A single-center, retrospective, non-observed cohort study.

**Patients:** From February 2010 to February 2016, we retrospectively analyzed 34 patients who underwent ECPR at UZLeuven.

**Measurements and main results:** Thirty-four patients who underwent ECPR were analyzed. Mean age was 39.5 years with an average Charlson comorbidity index of 1.4. Initial rhythm was vfi/pVT (ventricular fibrillation or pulseless ventricular tachycardia) in 20.6%, PEA in 35.3%, and asystole in 23.5% of cases. The average CPR duration was 53.5 minutes. Survival rate at 1 year was 23.5%. All survivors have a good CPC-score. The total CPR time was significantly shorter (< 0.05) in the survival group (32.5 min vs. 64.0 min). The lactate concentration at 12 h post CA is significantly lower in the survival group (p < 0.05). The pH at 6 h and the pCO2 at 3 are significantly higher and lower, respectively, in the survival group.

**Conclusions:** The frequency of PEA was notably higher in the ECPR survival-group. Since PEA is often caused by a reversible factor, it might be a good indicator of ECPR. Time to implementation of ECPR is notably lower in the survival group of ECPR (47.4 min survival group vs. 97.6 min non-survival-group).

There are no guidelines about inclusion criteria, exclusion criteria, or predictors of mortality. Hereby, it is nearly impossible to compare the results of performed studies due to heterogeneity in methodology. We recognize the need for strict guidelines for the execution of studies with similar methodology in multiple centers.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.092

### AP045
**Telephone assisted CPR: A literature review**

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**Introduction:** In the 1980s, first studies on telephone-assisted cardiopulmonary resuscitation (T-CPR) were performed but, so far, T-CPR is not realized area-wide, and neither national nor international T-CPR recommendations exist; moreover, specific guidelines available. The aim of this article is to give an overview on the extensive T-CPR topic.

**Methods:** Studies from the online database PubMed were identified and evaluated in addition to eight articles from PubMed about CPR in general. Preliminary information from the European Dispatch Center Survey (EDICeS) is included.

**Results:** Forty-two relevant studies were included. T-CPR is implemented in 87.6% of those dispatch centers which joined the yet unpublished EDICeS. According to German Resuscitation Registry data, approximately 10% of out-of-hospital cardiac arrest...
(OHCA) patients received T-CPR in 2014. Agonal breathing is the leading cause for non-recognition of OHCA via the dispatcher. Sensitivity of OHCA recognition by the dispatcher is approximately 75% with 8–45% of the patients with advised T-CPR not being in cardiac arrest. Injuries caused by chest compressions in patients not in cardiac arrest are rare. The time interval from call to first compression is between 140 and 328 s. Defined standards in the interrogation process shorten this interval and increase both sensitivity and specificity. Instructing rescue breathing by telephone is time consuming, leads to extensive hands-off times and, often, to ineffective ventilation: therefore, rescue breathings are not indicated in adults with primary cardiac arrest. Before and after implementation studies show improved survival with standardized T-CPR implementation.

Conclusion: T-CPR has been implemented since many years and is established in many dispatch centers by now. On the other hand, emergency call interrogation and T-CPR vary between the dispatch centers and are often performed without evaluation. International recommendations with standardized quality control are necessary and may lead to improved survival.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.093

AP047

CPR hands-only and AED “REAGIS” training applied for public people and for students in secondary schools in Luxembourg

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According to the 2015 ERC Resuscitation Guidelines, in order to generate more interest for CPR in the general population and to improve the survival rates after out-of-hospital cardiac arrest (OHCA), the Luxembourg Resuscitation Council (LRC) developed, in 2012, the three-step concept “REAGIS” – call 112 – press the heart – defibrillate the heart”. One-hour public training sessions supported by the ministry of health, in 60% of the communes of Luxembourg enabled to train more than 500 volunteers per year to CPR hands-only with an AED. A 20-minute theoretical introduction to CPR is followed by 40-minute participants CPR hands-only training with Mini-Anne™ and its AED model. The three steps “REAGIS – Concept” awakened the interests of secondary schools supported by the ministry of education. The project “Train the Trainer” concept of teaching teachers to apply “REAGIS” in their classroom was created.

Four secondary schools selected on voluntary basis participated from the academic year 2015 to 2016. An ongoing separate survey for students and for teachers was developed in order to state the effectiveness of acquired knowledge and practical skills for CPR hands-only and AED use. The final results of this project that will only be collected in June 2016 by the questionnaires are about the number of teachers and students participating in the project; the teachers’ general satisfaction, their satisfaction of the follow-up by the LRC, feelings about their qualification for teaching CPR hands-only and the difficulties encountered in the project; the students’ general satisfaction, their knowledge about resuscitation techniques and about the algorithm for RCP.

We hope that “REAGIS” in the public area, in secondary schools and in private business companies could be an important element in reinforcing the chain of survival in our country thereby improving survival rates after OHCA.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.095

AP048

Dispatcher-assisted cardiopulmonary resuscitation for patients with traumatic out-of-hospital cardiac arrest

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Introduction: Although the outcome of traumatic out-of-hospital cardiac arrest (OHCA) is generally grave, early recognition of cardiac arrest and prompt delivery of cardiopulmonary resuscitation (CPR) may improve survival. The purpose of this research was to determine the performance of dispatcher-assisted CPR (DA-CPR) for traumatic OHCA versus medical OHCA.

Methods: A retrospective, cohort study was conducted using the Tainan OHCA registry system during January 2014 to December 2015. The etiology of OHCA was defined by emergency medical technicians’ assessment. The audio recording of each emergency call was retrospectively retrieved and was reviewed. The
performance of dispatchers to recognize cardiac arrests and to deliver telephone instructions of CPR was evaluated.

**Results:** Of 4095 eligible adults (age range 8.0–104.0 years, mean 66.8 ± 18.0 years; male 64.9%) with OHCA, 507 (12.4%) (age range 10.0–94.0 years, mean 51.8 ± 19.8 years, male 72.2%) were defined as traumatic and 3462 (84.7%) (age range 8.0–104.0 years, mean 69.2 ± 16.5 years; male 63.7%) as medical. The dispatchers' recognition of cardiac arrest in the traumatic OHCA group, compared to the medical OHCA group, was significantly lower (8.3% vs. 42.7%, p < 0.05). Of those recognized as OHCA, the traumatic OHCA group had significantly longer time interval to recognition (60.1 ± 14.7 vs. 42.1 ± 18.8 s, p < 0.05), lesser bystander CPR before DA-CPR initiation (0.8% vs. 6.9%, p < 0.05), lesser major barriers of DA-CPR for traumatic OHCA included (1) failed recognition of cardiac arrest (47.9%), (2) physical distance of callers from the victims (36.4%) and (3) inability to evaluate the victim by the caller (33.5%).

**Discussions and conclusions:** The dispatchers' recognition of cardiac arrest and the performance of DA-CPR were generally poor for traumatic OHCA. The discrepancy of DA-CPR for various etiologies of OHCA should be considered.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.096

**AP049**

Knowledge, attitude and willingness towards cardiopulmonary resuscitation and automatic external defibrillators (AED) among public AED program managers in Taiwan

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**Background:** In Taiwan, certain public locations are required by law to install public automatic external defibrillators (AED) since 2013. Each public AED site should designate a manager to oversee AED registration/maintenance, education and incident report. This study was conducted to assess the knowledge, attitude and willingness of AED managers toward CPR + AED.

**Methods:** This cross-sectional study is launched by emailing a structured questionnaire to AED managers who registered in the “Taiwan Public AED Registry” website. This instrument includes demographics as well as knowledge, attitude and willingness toward CPR + AED practices and policies.

**Results:** Overall, 3810 managers were contacted and 1405 (37%) responded. A total of 83.4% participants completed manager course and 84.6% public places had site emergency plan. Knowledge on regulation and policy (92%) was higher than CPR + AED (83%). Willingness to perform CPR + AED (91.6%) was high, but to perform managerial duty was much less (68.7%). Fear of legal liability is the main reason for unwillingness to perform CPR + AED or to perform managerial duty. Better knowledge on CPR + AED contributed to more positive attitude (β = 0.55 ± 0.12, p < 0.001), and increased willingness to perform CPR + AED (OR = 1.35, 95% CI = 1.27–1.43, p < 0.001). In working places with a site emergency plan, the willingness to perform managerial duty is 2.19 times of those without (95% CI = 1.50–3.20, p < 0.001).

**Conclusion:** Site emergency plan for cardiac arrests is associated with better knowledge, attitude and willingness among AED managers in Taiwan, who play pivotal roles in program success. More frequent and updated training, especially on CPR + AED as well as AED laws, could translate into better attitude and willingness.

**Keywords:** Automatic external defibrillator (AED); AED manager; Site emergency plan

http://dx.doi.org/10.1016/j.resuscitation.2016.07.097

**AP050**

Frequency variation of ventricular fibrillation may help predict successful defibrillation in a rat model of cardiac arrest

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**Objective:** To evaluate whether the frequency variation of ventricular fibrillation (VF) helps to predict successful defibrillation in a rat model of VF cardiac arrest.

**Methods:** VF was induced in rats and maintained for 5 min, followed by cardiopulmonary resuscitation for 1 min and then defibrillation of 3 J. The first shock was considered to be successful if the animal regained organized cardiac rhythm with mean arterial pressure more than 60 mmHg after defibrillation. The electrocardiographic signals of 30 rats with first-shock success were obtained from our previous animal experiments, and 300 rats without first-shock success as control. The VF waveform immediately before the first defibrillation was analyzed and compared between the animals with and without first-shock success.

**Results:** There was no difference between these two groups in body weight, hemodynamic status before inducing cardiac arrest, VF-induced current, coronary perfusion pressure and end-tidal CO2 before defibrillation. The threshold of frequency variation was selected to be 9.5 to 9.5 Hz with sensitivity of 0.8, specificity of 0.583 and AUC of 0.708. The median variance of frequency variation in animals with first-shock success was significantly less than those without first-shock success (21.51, IQR 11.99–36.49 vs. 39.42, IQR 23.28–52.88, p = 0.000). Compared with amplitude spectrum area (AMSA) with sensitivity of 0.767, specificity of 0.547 and AUC of 0.678, combining frequency variation and AMSA significantly increases the predictability with sensitivity of 0.933, specificity of 0.493 and AUC of 0.732 (p = 0.005). All the animals in the first-shock success group regained spontaneous circulation, whereas 105 animals in the first-shock failure group did (100% vs. 35%, p = 0.000). Compared with only one electric shock in the first-shock success group, resuscitated animals in the first-shock failure group received 2.87 ± 0.99 shocks to gain return of spontaneous circulation (p = 0.000).

**Conclusion:** The frequency variation of VF may serve a useful parameter to predict defibrillation success during VF.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.098
AP051

Defibrillation success in out-of-hospital cardiac arrest: How important is recurrence of ventricular fibrillation after successful shock?

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Purpose of the study: In out-of-hospital cardiac arrest (OHCA) with ventricular fibrillation (VF), guidelines recommend defibrillation with biphasic shock,1 followed by chest compressions for 2 min before analyzing shock success. If VF is detected again, it is unclear whether VF sustained or – after being terminated by defibrillation – recurred within the 2-minute-cycle of chest compressions.2 We investigated the frequency of persistent versus recurrent VF under chest compressions after defibrillation with rectilinear biphasic shock.

Materials and methods: In Marburg-Biedenkopf-County, Germany (252,000 inhabitants), we enclosed 20 consecutive cases (starting March 2015) in a retrospective study of resuscitation attempts by ALS-ambulance in OHCA with initial VF. ECG recordings of the defibrillator corpus3 were analyzed by three independent investigators from the beginning of the CPR until 2 min after the third shock. ECG was edited with filters from 2 to 10 Hz to reduce chest compression artifacts. Successful shock was defined as termination of VF within 5 s after the shock.3 A relapse was defined as recurrent VF in the interval of 5 s after a shock and the subsequent shock.

Results: We analyzed 54 shocks of 20 patients. 68.5% of the shocks were successful (n = 37), but the recurrence-rate of VF was 81.1% (n = 30). Shock 1 (n = 20) was successful in 75% (n = 15) and VF recurrence rate was 86.7% (n = 13). Shock 2 (n = 18) was successful in 72.2% (n = 13); VF recurrence rate was 84.6% (n = 11). Shock 3 (n = 16) was successful in 56.3% (n = 9); VF recurrence rate was 66.7% (n = 6).

Conclusions: Although VF was terminated by rectilinear waveform defibrillation in 69%, VF recurred within 2 minutes of chest compressions in 81%. As it is unclear the extent to which chest compressions influence the risk of VF-relapse after successful shock, further studies need to re-evaluate the best shock-compression-analysis algorithm for OHCA with initial VF.

References

http://dx.doi.org/10.1016/j.resuscitation.2016.07.099

AP052

Should paramedics use automated external defibrillators?

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Purpose of the study: Kern et al. indicated that even short chest compression interruptions reduced myocardial perfusion and survival.1 Therefore, ECG interpretation and defibrillation must be performed fast. The study compared delays for rhythm analysis and defibrillation in paramedics using a manual defibrillator (MAN; LIFEPAK 15; Physio-Control, USA) and an automatic external defibrillator (AED; Samaritan PAD 300 Trainer; HeartSine, USA).

Materials and methods: The trial involved 34 paramedics who received training on ERC guidelines and various defibrillators usage. The analysed time parameters were, from defibrillator turning on to: T1, the beginning of ECG interpretation; T2, rhythm recognition; and T3, defibrillation performance. A SimMan 3G manikin (Laerdal, Norway) presenting ventricular fibrillation was used.

Results: During the first rhythm assessment, the average T1 for MAN equalled 5 (IQR, 4–7) seconds, significantly less than for AED (33 [IQR, 31–34] seconds) (p < .001). T2 was 11 (IQR, 10–14) vs. 42 (IQR, 40–44) seconds, respectively (p < .001). T3 with MAN was also significantly shorter than for AED (22 [IQR, 21–24] vs. 47 [IQR, 45–50] seconds, respectively; p < .001). While rhythm reassessment after 2 min of CPR, significantly shorter times were observed for MAN compared with AED both for T2 (5 [IQR, 4–7] vs. 15 [14–17] seconds, respectively; p < .001) and T3 (16 [IQR, 15–18] vs. 21 [IQR, 20–25] seconds, respectively; p < .001).

Conclusions: Time delays for rhythm recognition and defibrillation by paramedics were significantly shorter for MAN than for AED. Rhythm interpretation knowledge allows faster manual defibrillation compared with AED.

Reference

http://dx.doi.org/10.1016/j.resuscitation.2016.07.100

AP053

Validation of a national public access defibrillator database in Belgium

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Purpose of the study: The new ERC Guidelines 2015 emphasises timely deployment of an automated external defibrillator. This study analysed and validated the current use of public access defibrillators (PAD) in Belgium, in the perspective of the current recommendations.

Materials and methods: Firstly, we carried out a systematic literature search to identify recommendations concerning PAD placement in public areas. Secondly, we requested the exact location of all available PAD databases in Belgium for analysis. After merging all available databases together, we validated a large sample of the unique PAD entries by applying a target questionnaire.

Results: Our literature search yielded 77 studies and 19 manuscripts from additional resources. Public transportation terminals, playgrounds, casinos, golf courses and private homes are within the top 5 locations with a higher frequency of OHCA occurrence then average.

The most complete PAD database included 6300 data entries. Each entry described some information on the owner and the location of the PAD. After plotting the PADs, using commercially available software (Tableau 9.1.2), we noted that, in rural areas, coverage of Belgian PADs is limited. Equally important, we found that...
availability of the PADs was mostly associated with commercial or other dedicated opening times of hours.

Conclusions: At present, there are no reliable resources with accurate data on PAD status in Belgium. Included databases provided no structure nor validated data on PAD availability as registration is not mandatory and updates rely solely on goodwill of the owner to provide correct information. Timely deployment of an AED in Belgium is currently a matter of being at the right place at the right time: nationwide training programs for the public cannot integrate a bystander-driven PAD strategy.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.101

AP054

Forty-min systematic dispatcher education increases the number of speaker activations in continuous telephone CPR

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Purpose: ERC guidelines recommend medical emergency dispatchers (MED) to provide telephonic CPR in cases of suspected cardiac arrest, and encourage the bystander to switch the speaker function on.

It has only been possible to find evidence of bystanders’ capability to activate speaker function in test settings, and nothing about education of the MED.

The typical MED in our organization are experienced nurses, but not necessarily experienced as mobile phone ‘help desk’ operators. The aim of this study is to evaluate a structured 40-min systematic education.

Materials and methods: In a 5-month period, we undertook a systematic prospective registration of the bystander capability to activate the speaker function.

Included were all calls where there was a suspected cardiac arrest, and from these we excluded cases where it was obviously out of scope to ask.

After 3 months of registration, a mandatory structured 40-minute education called ‘mobile phone speaker activation’ was introduced.

The education included general information about mobile phone speaker function, practical simulations with a mannequin and training with three different mobile phones. Both the role as bystander and MED were trained, and the instructor/participant ratio was 1:1 or 1:2.

Results: The total number of calls was 28,972; 62.3% of those asked before the education with a phone that has a speaker function were able to turn the speaker on. After the education, the capability increased to 72.2%; 100% of MED agreed that the course was relevant and the teaching method was good, and 87% agreed that they became more prepared to guide the bystander.

Conclusion: Before the education, the 62.3% initial capability to turn on the speaker function was better than expected. After the structured education, the capability was increased to 72.2%.

This structured 40-minute education was a success and is easily adapted and implemented.1, 2

References


http://dx.doi.org/10.1016/j.resuscitation.2016.07.102

AP055

#SCUOLESICURE: A sustainable and effective project for CPR teaching in Italian schools

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Purpose: European Resuscitation Council has issued Kids Save Life statement to stimulate CPR teaching in schools and in Italy a law has been introduced for mandatory first-aid education in schools, although nowadays no teaching pattern has proven to be effective and sustainable. The charities Pavia nel Cuore and Robbio nel Cuore realized a provincial-extension project, called #SCUOLESICURE (literally “SAFESCHOOLS”), for the curricular teaching of CPR with the main purpose to verify if it could be a valuable project to be adopted throughout Italy.

Methods: We involved all 20 secondary schools of Pavia province teaching CPR to all final-year students through mass
training (45 min of theory and 75 min of practice on a MiniAnne manikin with an instructor:attendee:manikin ratio of 1:15:15) and to all physical education (PE) teachers with a 5-hour BLS/AED course. We provided every school with ten manikins and we demonstrated to all the PE professors how to correctly use the manikins and shared a specially created DVD in order to teach CR to students in the following years. Furthermore, an AED was positioned in each school.

Results: In one school year, we trained approximately 3500 students and 150 teachers. We estimate that, in the next 5 years, teachers will train approximately 35000 students throughout the province of Pavia, constituting approximately 6% of the inhabitants. We believe that such massive teaching will increase survival rates after out-of-hospital cardiac arrest in our province. This effect will be evaluated in the next few years through the analysis of data from the Cardiac Arrest registry of Pavia Province (Pavia CARE).

Conclusions: The #SCUOLESICURE project has proved to be sustainable and effective for CPR teaching to Secondary School students. This approach might be considered as a template for use throughout Italy for teaching CPR as required by the current law.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.103

AP056

Let’s play Relive! Young people may learn how to save lives with a serious game

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Purpose of the study: Relive is a game wherein players can learn cardiopulmonary resuscitation (CPR). The main purpose of this game is to increase the awareness on CPR and prompt people, especially teenagers and young adults, to attend a CPR class and be prepared to intervene in the case of cardiac arrest. Relive is part of the Kids Save lives campaign in Italy from October 2015.

Materials and methods: Relive is a first-person 3D adventure in the near future on planet Mars. The game is divided in 2 different modes: Tournament and Story. Tournament mode is a ready-to-play simulated emergency scenario, taken from selected game scenes, where the player faces different rescue situations and test his CPR skills directly. In the Story mode, the player has to acquire the basis of CPR manoeuvres in order to continue forward in the story. To keep the CPR skills razor sharp and for a fun and fast CPR challenge, the tournament mode may encourage group play. Indeed, family members, schoolchildren, and groups of friends may challenge themselves to beat the best score.

Results: Relive was released for free on Steam (http://store.steampowered.com/app/404580) on 15th October 2015. Steam is one of the biggest digital distribution platform offering multiplayer gaming and social networking services. Relive was downloaded by 32742 users all over the world with an overall “mostly positive” user review (800 downloads per week).

Conclusions: Serious games like Relive are extremely promising for resuscitation trainers and educator communities as a tool for spreading important messages to the lay public and especially to young people.1,2

http://dx.doi.org/10.1016/j.resuscitation.2016.07.104

AP057

The impact of the new HybridLabTM self-direct simulation training programme on successful gaining skills in ambulance service

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Purpose of the study: The new HybridLabTM self-direct simulation training programme for learning to fill electronic data cards (EDC) was implemented in Kaunas Ambulance Service since December, 2015. Immediately after programme completion, the ambulance staff began to use EDC in the clinical practice. The purpose of the study was to evaluate the impact of the programme on the satisfaction of participants and self-evaluation of skills 3 months after the programme.

Materials and methods: During 6 weeks, 130 specialists of ambulance team were trained. The programme was grounded on social constructivist theory, cognitive theory of multimedia learning and based on electronic/digital learning materials, HybridLabTM, collaborative and cooperative learning. The parts of learning process were: (1) learning to fill EDC by using DRAKON algorithms, video materials, acquiescing automatic skills and solving tests; (2) simulated situations (myocardial infarction (MI), stroke and trauma) with EDC filling in the equipped Hybrid laboratory. We evaluated both programme evaluation’s forms that were filled by 69 (53.08%) participants working with EDC in real life 3 months after the programme.

Results: Overall, 95.6% of participants declared the usefulness of programme, 82.6% had knowledge on how to fill EDC, 95.7% absolutely independently filled EDC and 89.9% had increased enthusiasm for filling EDC. After the programme, men had more self-confidence in trauma situations than women (p = 0.03). Doctors more often declared team work than nurses (p = 0.03), and had self-confidence in MI situation than paramedics (p = 0.01). There were no other differences between age, gender and speciality. After 3 months, compared to immediately after completion, enthusiasm to fill EDC (p = 0.00) and the usefulness of the programme (p = 0.056) were increased.
Djärv
concern to many physicians. This is not only a threat to patient safety, but also a personal concern to many physicians. Diabetic arrests are unusual and refresher sessions for physicians are preferably annually. Outside cardiology and emergency care, cardiac arrests are unusual and refresher sessions for physicians are sparse. This is not only a threat to patient safety, but also a personal concern to many physicians.

Purpose of the study: To examine the preparedness for advanced CPR among hospital staff physicians (not cardiology/emergency) before and after a regular course in advanced CPR.

Material and methods: 120 doctors participated. A questionnaire was filled in before the course date, investigating date of last CPR training, length of training, perceived preparedness for emergency action at cardiac arrest and knowledge of how to operate a defibrillator.

The 4-hour course was conducted, and evaluated with a questionnaire investigating the actual perceived preparedness to diagnose cardiac arrest, perform CPR, interpret arrhythmias, operate a defibrillator, prescribe emergency drugs and how to manage team resuscitation efforts.

Results: Fifty percent of the doctors had undergone CPR training >3 years earlier, 40% >5 years earlier and 28% had never had advanced CPR training. In the pretest, 67% were lacking confidence to act in emergencies, and 65% admitted they were uncertain about the operation of an Automated External Defibrillator (AED). All participants experienced a noticeably greater security and preparedness regarding diagnostics, technology, methodology and trust in acute life-threatening conditions after the course.

Conclusion: Doctors are expected to intervene with both medical expertise and leadership in acute unexpected events. If they experience uncertainty and do not have knowledge of basic clinical skills in the field, confusion appears among the staff and patients, whose lives could have been saved, are lost. Regular monitoring of doctors’ CPR skills must, therefore, be implemented.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.105

AP059
DARE trainers pedagogy development using 2-round Delphi methodology
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The Dispatcher-Assisted first REsponder (DARE) programme is a local public awareness programme that aims to equip participants with sufficient skills to perform basic CPR and to use an AED. By familiarising them with instructions given by a medical dispatcher during a real-life out-of-hospital cardiac arrest call, participants will be prepared to react when faced with emergencies. Currently, there is an absence of a structured curriculum for DARE. The skills and information imparted to the participants by the trainers have been varied. Using a top–down method, we aim to make recommendations to a constructive trainers’ programme, to formalise the curriculum and standardise the way information is conveyed to the participants of dispatcher-assisted resuscitation programmes.

A panel of 20 experts from Singapore, all either well-versed in CPR and AED or with previous participation experience in DARE or similar programmes, were recruited. Using the Delphi methodology, the issues in 10 core areas selected were classified into open- and close-ended (multiple choice, ranking, yes/no) questions. Consensus for an item was established at a 70% agreement rate within the panel. Questions that had 60–69% agreement were edited and re-sent to the panel for re-voting.

After two rounds of voting, the panel agreed on 59 consensus statements. The recommendations covered the following: the focus of general CPR; standardisation of training session; qualities and qualifications of trainers and instructors; assessment of trainers; warning signs of cardiac arrest; head-tilt-chin-lift coverage; landmark for chest compression; resuscitation guidelines; performance of CPR when injuries are present; trainers’ involvement in training lay people; modesty of female patients during CPR; usage of and familiarity with AED; addressing of questions and answers; updates-dissemination to trainers and attendance of refresher courses.

Recommendations for pedagogy for trainers of CPR programmes were developed using the Delphi method. These recommendations should be validated in practical settings.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.107

AP060
The skill and the will: First aid education to increase bystanders’ propensity to act in Canada
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Purpose: The true value of first aid training is only realised when applied in an emergency. This study took activities developed by the
undisclosed agency 1 to increase an individual’s propensity to act and applied them to first aid learners in Canada. The objective was to test what effect different activities would have on willingness to act.

**Method:** Activities to increase willingness to act were added to the (undisclosed agency 2) ‘Emergency First Aid’ course (1-day course). This ‘test’ course was compared to a ‘control’ course. A sample of 199 participants across six locations in Canada was used. Propensity to act was measured as willingness and self-efficacy. Participants completed pre- and post-course questionnaires rating willingness to help; self-efficacy to use first aid skills effectively; and (post only) changes to pre-identified fears about helping.

**Results:** Participants in all training sessions, including the control, showed an increase in willingness to help and in confidence. However, test course participants showed: a lower percentage with ‘no change’ to ratings, a higher percentage who were ‘much less’ concerned with pre-identified fears, and a greater range of increased confidence.

**Conclusion:** While not conclusive, when participants are provided with an opportunity to explore how they feel about an emergency, they make meaningful connections with the training which better prepares them for real-life application. To reduce barriers to bystander interventions, we need a broader approach to First Aid Education – beyond clinical skills to developing the will to act. We need to look beyond what we want participants to learn and consider how to best prepare them as first aiders.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.108

**AP061**

**Is the common approach to teaching ALS skills cost-effective?**

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**Purpose:** Medical education requires time and resources, but when we anticipate the cost of an endeavour, there is more than just a financial value to consider. This study broadens the definition of cost within the theoretical framework of symbiotic clinical education.1 This framework considers the stakeholders involved in clinical education beyond just the student and the teacher, but also the clinician, teaching institution, health service and patient.

**Methods:** In a mixed-methods study, we compare the cost of teaching advanced life support (ALS) skills between the four-stage skill teaching approach (4SA) internationally advocated for use in ALS courses and a more traditional two-stage approach (2SA). We ran a randomised controlled trial, financial review of materials, interviews, focus groups and surveys to understand the comparative costs and benefits of both methods, including time, resources, patient risk, cognitive demand on the educator, and student competence.

**Results:** Patient outcomes between the two teaching interventions are comparable, though 4SA instruction is more expensive in terms of time and resources. Educators report varying levels of difficulty using 4SA with cognitive load on the educator identified as a significant burden.

**Conclusions:** While the patient outcomes in our study are comparable, the increased time and resources required to teach with 4SA may place an increased burden on teaching organisations and educators already strained by the demand for their service.2

References

http://dx.doi.org/10.1016/j.resuscitation.2016.07.109

**AP062**

**Attitudes and preferences of high-risk cardiac patients and their family members towards basic life support training: A qualitative study**

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**Background and objective:** Patients with heart disease are at high risk of repeat cardiac events, including cardiac arrest. Targeting basic life support (BLS) training to their family members has long been advocated. We wanted to understand the attitudes and preferences of this group towards BLS training.

**Methods:** We conducted semi-structured interviews with cardiac patients and their spouses. Interviews were transcribed verbatim and a thematic analysis conducted, underpinned by a phenomenological perspective.

**Results:** Twelve semi-structured interviews with patient/spouse pairs were conducted, on average, 7 weeks after hospital discharge. Purposive sampling was utilised to ensure a heterogeneous sample of males (75%) and females with ages ranging from 47 to 75 years. When participants were asked if they were interested in training, three main themes emerged: the worthiness of training should be timed after hospital discharge. Cardiac rehabilitation was identified as a time and place where BLS training could be implemented. Self-instructional BLS training kits were considered an acceptable learning method by participants, accompanied by face-to-face instruction, particularly to reinforce chest compression depth.

**Conclusions:** High-risk cardiac patients and their spouses have positive attitudes towards BLS training. Preferences were for training after hospital discharge, via self-instructional training kit with a face-to-face component, at cardiac rehabilitation. These findings will assist in designing a BLS training program for this high-risk target group.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.110
AP063

Resuscitation education in television medical dramas: The TVMD study

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Purpose: To identify the fidelity of television medical drama (TVMD) episodes with established cardiopulmonary resuscitation (CPR) guidelines, and to assess the outcome of these therapeutic interventions per type of series.

Methods: A survey instrument was created to score 100 episodes of 7 TVMD by trained advanced cardiac life support providers. The following variables were evaluated and scored: Cause of the cardiac arrest, compression rate, interruptions during providers. The following variables were evaluated and scored: Cause of the cardiac arrest, compression rate, interruptions during CPR, appropriate position in arms and hands, return of spontaneous circulation (ROSC) and outcome to hospital discharge.

Results: A total of 100 episodes from diverse TVMD were reviewed. A total of 72 resuscitation attempts requiring CPR were identified. Trauma was the leading cause for cardiac arrest in 54.2% of patients [CI 42.7, 65.3], followed by cardiac origin in 20.8% [CI 12.7, 31.2]. Males suffered cardiac arrest more frequently than females (72.2% [CI 61.2, 81.5] vs. 27.8% [CI 18.5, 38.8]). Compression rates were inadequate in 62.5% [CI 51.0, 73.0]. CPR was interrupted in 54.2% of victims [CI 42.7, 65.3]. An inappropriate position of hands was noted in 52.8% of the rescues [CI 41.3, 64.0]. Observed ROSC rate was 66.7% [CI 55.3%, 76.7%]. Survival to hospital discharge was observed in 30.8% [CI 18, 46.2%] of all resuscitations. In 33 patients with ROSC, the actual outcome was not mentioned.

Conclusions: Based on current CPR guidelines, the technique depicted in TVMD was inadequate in the majority of episodes reviewed. As TVMD may serve laypersons as a source of medical knowledge, it is important to portray accurate information to improve the fidelity of resuscitation techniques shown on TV. High rates of positive primary and secondary outcomes might give viewers false expectations towards survival after cardiac arrest.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.112

AP065

The satisfaction of different ambulance staff on the HybridLabTM self-direct simulation training programme

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Purpose of the study: The electronic data card (EDC) could be used for documentation of medical assistance actions. It is easy to fill and records the sequence of events and actions. Before implementation of EDC in an ambulance, the staff was trained. The purpose of the study was to evaluate the satisfaction of participants on the new learning programme on filling the EDC and solving clinical situations.

Materials and methods: Remote HybridLab™ self-direct simulation training 6-week course was held in the Kaunas ambulance service since December 2015; 130 specialists of the ambulance team (doctors 23.8%, paramedics 26.92%, nurses 47.69% and other 1.54%) were trained. The learning process components were: (1) selection of the most convenient time, place and team; (2) preparation for the topic by watching videos and familiarizing with DRAKON algorithms, scenarios and tests; (3) practice with EDC and in the equipped laboratory solving simulated clinical scenarios; (4) the student acquiesces automatic skills. At the end of

Reference


http://dx.doi.org/10.1016/j.resuscitation.2016.07.112

AP064

A breathtaking picnic: A fairy tale to save lives

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Purpose of the study: Italian Resuscitation Council (IRC) supports the use of multimedia tools to increase the awareness of the general population and young people about cardiac arrest and airway obstruction. For this reason, IRC developed a fairy multimedia tale, downloadable for free on tablets and smartphones, with which kids can learn first aid principles. The story of Tum-Tum the Bear and the Squirrel Family is a playful way of conveying a fundamental concept: in case of cardiac arrest and choking, we can take action with no fairy! Indeed, a few simple steps are needed, which kids can learn playing the game. The breathtaking picnic was launched during the Viva! Campaign on October 2015 and updated on May 2016 with a new game session. We have now collected data from App Store and Google Play and we analyzed social network trends till May 2016.

Results: A breathtaking picnic became the top downloaded app in the children categories during May 2016 with over 20,000 downloads. We invited 10 Mum Blogger influencers in a dedicated “pic-nic” app launch event on 12th May. One hundred and seventy-four influencer tweets followed the event and the hashtag #unpicnicomozzafiato became the second trend topic followed in Italy.

Conclusions: IRC believes that app fairy tales and serious games represent a valid investment to increase awareness and to teach CPR to kids [1].

http://dx.doi.org/10.1016/j.resuscitation.2016.07.112
the programme, 107 participants filled the evaluation’s form. We evaluated the answers of 44 questions about each part of the programme according to age, gender and speciality.

**Results:** Self-confidence in the filling of EDC independently was reported in 84.17% of participants; 96.2% of participants declared the effectiveness of HybridLab™ training; 90.65% were satisfied with video materials and tests, 84.1% with simulated situations and 86.00% with algorithms. According to age, there were differences in the usefulness of the programme \((p = 0.03)\), increased enthusiasm for filling EDC \((p = 0.01)\) and learning without mistakes \((p = 0.02)\). Women, more than men, understood information in the Internet database \((p = 0.049)\). Nurses declared lesser possibility of asking the instructor than doctors \((p = 0.04)\). There were no other differences between age, gender and speciality.

**Conclusion:** The HybridLab™ learning programme ensures standardized, high-quality training for large and different groups of staff.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.113

**AP066**

**Greek teachers’ awareness and practices regarding first aid**

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**Purpose:** An accident is defined as any instantaneous event causing physical or mental harm or life loss that cannot be foreseen. Regarding children’s accidents, parents and teachers are the usual witnesses and education in first aid is crucial. The aim of this study was to investigate awareness, attitudes and practices of high school teachers related to basic first-aid practices and factors affecting the willingness of knowledge.

**Methods:** Data were obtained from 145 teachers in 25 high schools in Peloponnese, Southern Greece using a self-administered anonymous questionnaire for sociodemographic properties, level of knowledge related with first-aid practices and teachers’ willingness for first aid education. The preparation of the questionnaire was designed to be simple and understandable citing specific questions in order to minimize the likelihood of confusion.

**Results:** 145 questionnaires were answered (RR 58%). 97 responders were female (66.8%). Average age of the sample was 44 ± 7.8 years. The great majority of teachers (66%) were willing to administer first aid, but only 21.15% of responders felt adequate to implement first aid; 42% of teachers referred to a lack of equipment. Only 45 (31%) have attended first aid seminars (27.5% of men and 17% of women). Among teachers that have provided first aid, practice was considered poor and moderate in 6% and 32%, respectively; but in cases where seminars have been followed up, 89% considered their response excellent to satisfactory. Of great importance is teachers’ willingness for education in first aid techniques (95.17%).

**Conclusions:** Teachers’ training in first aid is poor. Since teachers are often the first individuals to witness and handle situations requiring first aid, such seminars and courses should be included in continuing education programs.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.114

**AP067**

**The resuscitation course increased the number of successful resuscitations and good neurological outcome**

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**Aims:** The primary outcome was evaluation of the influence of the CPR course on the level of CPR knowledge of paramedical staff and on neurological outcome of all in-hospital successfully resuscitated patients. Secondary outcomes were the factors with influence on knowledge. We analysed all successful resuscitations during the years 2006–2015 including evaluation of their neurological outcome.

**Material and methods:** 408 paramedical staff members took part on a voluntary basis in this research; 217 successfully resuscitated patients during 2006–2015 were included in this retrospective analysis. Quantitative research was conducted by a questionnaire administered by us for determining the level of CPR knowledge of paramedical staff and retrospective analysis of all successfully resuscitated patients during 2006–2015.

**Results:** Factors with confirmed influence on the level of knowledge of CPR are: the undertaking of CPR course, duration from last CPR course, type of department where the respondent works and participating in real CPR. No relationship was observed in age, length of professional experience and education level. We observed 72 successful CPRs in the period 2006–2010 with 26.39% CPC 1,2 at ICU discharge were observed. After the CPR course implementation, 145 successful CPRs in the period 2011–2015 with 35.17% CPC 1,2 at ICU discharge were noted. We found statistically significant correlation between age, ROSC, type of initial rhythm, place of CPR and neurological outcome.

**Conclusion:** Knowledge of CPR of paramedical staff is at a very good level. After implementation of the CPR course, the number of successful CPRs increased and better neurological outcome was observed.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.115

**AP068**

**Addressing clinician burnout: How can we build resilience in tomorrow’s health professionals?**

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**Purpose:** The clinical impact of burnout is known to threaten patient care,1 but the personal impact is much more difficult to measure. In Victoria, Australia, employment as a paramedic/ambulance clinician has been found to correlate to a four-fold higher suicide rate than the average population.2 Both educational and health service organisations have a responsibility to equip and encourage student clinicians and staff to address this issue. We set out to determine the extent and effects of burnout in pre-hospital clinical medicine, and to identify what strategies exist to manage this problem.

**Methods:** We conducted a literature review to identify evidence relating to burnout and chronic stress in pre-hospital clinicians.

**Results:** Although there is an increasing prevalence of studies relating to burnout in medical practice, very few address the unique context and pressures of ambulance practice.
Emergency physicians have been found to have the highest rates of burnout compared to other medical specialties in a recent study. In the groups studied, emergency physicians face work challenges that are most similar to pre-hospital emergency health professionals. Mindfulness is presented as a strategy demonstrated to mitigate burnout in some clinical education settings.

**Conclusion:** As tomorrow’s clinicians are trained and supported to nourish their emotional resilience as a preventative tool against burnout, the personal and clinical impact is expected to lessen.

**References**

1. El-bar N, Levy A, Wald HS, et al. Compassion fatigue, burnout and compassion versus 80% (control) indicated that they would do both compressions and ventilations, and, at 6 months, 37% versus 34% (NS).


**AP069**

**Involvement of elite athletes in a CPR educational program for seventh grade students did not influence practical CPR skills or willingness to act: Report from a cluster-randomized trial**

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**Introduction:** Professional athletes may act as role models and promote healthy lifestyle among adolescents. We hypothesized that involving athletes in CPR education might promote learning.

**Aim:** Investigate if elite athlete participation in CPR training program affects practical CPR skills or willingness to perform bystander CPR in seventh grade students.

**Methods:** Twenty-two classes were randomized to CPR training only (control-group) or to a visit from two elite athletes prior to the CPR training (intervention). During a 60-min visit, the athletes discussed the importance of acting in a cardiac arrest (CA) situation, showed a video on a CA during a sports event and promoted health lifestyle choices to prevent cardiovascular disease. Practical CPR training was performed within a week of the visit and followed ERC guidelines. CPR skills and willingness to act were assessed directly after training and at six months in both groups, using a PC Skill Reporting System (total score 12–48) and a questionnaire. Training and measurements were performed from December 2013 to October 2014.

**Results:** There were no significant differences between the intervention group (n = 243) and the control group (n = 208) with regard to the total score of practical skills; directly after training 35 (32–37) versus 34 (31–37) points, and, at 6 months, 34 (31–36) versus 33 (29–36) points. Directly after training, 87% (intervention) versus 80% (control) indicated that they would do both compressions and ventilations if a relative suffered a CA, and, at 6 months, 80% versus 78% (NS). If a stranger suffered a CA, 47% (intervention) versus 42% (control) stated directly after training that they would do both compressions and ventilations, and, at 6 months, 37% versus 34% (NS).

**Conclusions:** The involvement of elite athletes in a CPR educational program prior to practical CPR training did not influence CPR skills or willingness to act in seventh grade students.

**Keywords:** Cardiopulmonary resuscitation; Training; Elite athletes; Students; Willingness

**References**


**AP070**

**Field triage education of trauma among emergency medical technicians in Taiwan**

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**Background & objectives:** Injury is the ninth leading cause of death in the world and treating severely injured patient in a trauma centre can reduce mortality by 25%. Therefore, adequate recognition of severely injured patients in the prehospital stage is very crucial. The American College of Surgeons Committee on Trauma (ACSCOT) developed a prehospital field triage scheme that is modified/used by many prehospital systems. It mainly includes: (1) Physiologic status (P); (2) Anatomical injury (A) and (3) Injury mechanism (M). There is no educational study about field triage for emergency medical technician (EMT). Therefore, this study aimed to evaluate the accuracy of EMT before and after an educational class.

**Methodology:** We designed a 30-min lecture and 5 pre- and post-test questions (including 2M, 2A and 1P) were designed for evaluating EMT performance. EMT-II and paramedics of Taipei and New Taipei City joined the lecture during September 2015–March 2016.

**Results:** There were 948 (96.9%) EMT-II and 84 (94.3%) paramedics included from all of Taipei city in the educational class. EMT-II and total group accuracy improved in all aspects (P < 0.01), Paramedics improved in physiological aspects and mechanism, but failed in anatomical aspect (P > 0.05). Paramedics were not more accurate than EMT-II in all aspects (P > 0.05). Anatomical knowledge was more accurate in pretest, but there was less improvement. There was significant correlation between experience of 1 year and post-test correct answers (P = 0.037/0.002). There is no significant correlation between accuracy and seniority of paramedics in the paramedic group, but this had a positive coefficient with pretest accuracy (0.058) and negative coefficient with posttest accuracy (−0.094).

**Conclusion:** Field triage education can improve accuracy of EMS provider. Anatomical knowledge is harder to improve. More clinical experience can help improve accuracy of field triage. We
suggest that lecture design should have greater emphasis on anatomy.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.118

AP071

The French national cardiac arrest registry as a source of professional practices assessment

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Introduction: Care quality is a primary concern in the health care field. In France, professional practice assessment (PPA) is compulsory for practitioners. It is the first step towards an excellence culture. Indeed, they are able to assess and improve their practices. Competent authorities define registries as reliable sources for PPA. Our study aimed to provide a specific PPA model for out-of-hospital cardiac arrest (OHCA) care based on the French national cardiac arrest registry (RéAC).

Materials and methods: We built our PPA adapting in-hospital pre-existing indicators for OHCA. Centre results are compared with national data. An international guideline reminder is added when it exists. Results can also be compared on two time periods. User satisfaction was evaluated via a questionnaire.

Results: Our PPA is divided into three parts. The first one (24 items) describes the quality and traceability of the emergency medical file. In the two other parts, we separated traumatic cardiac arrests (28 items) from medical (25 items). A simple user request generates the PPA. Our PPA is well accepted by the emergency professionals. Indeed, 66.6% downloaded their PPA for a quality assessment. Our PPA is judged useful by 92.6% of responders. The comparison of results with national data and guideline reminder is appreciated by 96.3% of responders.

Conclusions: We built a fully automatized, online and user-friendly PPA. This tool was designed and tested on the RéAC, which uses the Utstein style for the data collection. It enables in the PPA a transferability for other registries that follow the Utstein style. RéAC provides PPA source codes on request. This tool was well received by emergency staff. Our PPA enables care practices assessment and, then, their improvement. The repetition of those steps will lead care practices to an excellence culture.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.119

AP072

Performance improvement of paramedics after a low-dose high-frequency retraining course of endotracheal intubation

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Background: Prehospital endotracheal intubation (ETI) is a prominent intervention in paramedical care worldwide. However, the best strategy for retaining the skill remains unclear. This study aimed to evaluate the effect of a low-dose high-frequency retraining course of ETI on the performance changes of paramedics.

Methods: This prospective study enrolled certificated paramedics in Taipei City. The intervention was a 4-h retraining course of ETI split into 3 sessions of monthly retraining, including in the first month a 1-h standardized lecture and 1-h intubation test (T1), followed by the second month (T2) and third month (T3) of only 1-h intubation test and immediate feedback. Outcomes were their performance changes including the practical session of ETI on the manikin evaluated by a structured record, and the success rates of ETI for patients in the prehospital setting. Stratified analyses by their experiences of intubation and seniority were also done.

Results: From 1 September to 31 November 2015, 88 paramedics joined the T1, and 81 completed T3. All enrollees had significant improvement in the aspects of troubleshooting of invisible vocal cord (T1: 40.3%, T2: 81.5%, T3: 91.4%, p < 0.05) and confirmation of intubation (T1: 92.0%, T2: 98.0%, T3: 97.6%, p < 0.05). Prehospital success rates of ETI examined by 3-month periods showed no difference (before retraining: 69.8%, during retraining: 63.3%, after retraining 65.6%, p = 0.76), probably with seasonal interaction (lower success rates in winter by historical data). However, for paramedics with seniority ≥5 years, success rates were significantly improved (before retraining: 45.1%, during retraining: 54.5%, after retraining 86.7%, p < 0.05). Paramedical experience of intubation was not associated with the retraining effect.

Conclusions: A low-dose high-frequency retraining course of ETI can improve paramedic intubation skill on the manikin, and significantly improved the success rate of prehospital intubation in paramedics with seniority ≥5 years.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.120

AP073

Life support in the compulsory education of the schools in Catalonia: Formation in spiral

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Purpose of study: The aim of this study is to raise health awareness of the school-leaving children who complete compulsory education in Catalonia so they know how to act when they
watch a sudden death to perform life support (LS) manoeuvres. We also expect this knowledge to be maintained over time.

**Material and methods:** In 2007, a pilot plan began to include life support education within the school curriculum. A working group of teachers, with the support of the Consell Català de Ressuscitació, Barcelona, Spain, proposed: (1) a curriculum in a spiral learning structure for all students in compulsory education stage (from 3 to 15 years); (2) the necessary teaching material: programming units, teacher documentation, student’s documentation; and (3) the structure of teacher’s training.

Once the pilot plan ended, this program was offered to several educational centres throughout Catalonia. Since then, the project has been growing.

A pyramidal structure was developed to organise, monitor and update the whole programme and also for the management of all issues related to Basic Life Support in schools (BLSs). In 2014, the Department of Education from the Catalonian Government signed an agreement supporting and endorsing the program.

**Results:** The programme is being deployed with the following distribution

<table>
<thead>
<tr>
<th>School year</th>
<th>Educational Centres included in the BLS programme</th>
<th>Trained teachers</th>
<th>Trained students</th>
</tr>
</thead>
<tbody>
<tr>
<td>2015/2016</td>
<td>95</td>
<td>213</td>
<td>18.727</td>
</tr>
<tr>
<td>2014/2015</td>
<td>18</td>
<td>61</td>
<td>10.789</td>
</tr>
<tr>
<td>2013/2014</td>
<td>11</td>
<td>15</td>
<td>6.501</td>
</tr>
<tr>
<td>2012/2013</td>
<td>2</td>
<td>5</td>
<td>3.701</td>
</tr>
<tr>
<td>2011/2012</td>
<td>11</td>
<td>21</td>
<td>2.556</td>
</tr>
<tr>
<td>TOTAL</td>
<td>137</td>
<td>313</td>
<td>42.274</td>
</tr>
</tbody>
</table>

**Conclusions:**

- Students ending compulsory education at age 14 can perform BLS manoeuvres following the ERC guidelines and have embraced the contents and assimilated the skills learned.
- It is still pending assessment of the retention of knowledge and skills over time and comparison of the knowledge acquired through this program with the standard adult training.

A computerised database is still missing.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.122

**AP074**

**Engineering student education in cardiopulmonary resuscitation via virtual reality**

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**Purpose:** The purpose of this work is to motivate engineering students to learn cardiopulmonary resuscitation (CPR). A recent survey of first-year engineering students at the University of Rhode Island indicated that less than 16% had the ability or knowledge to perform CPR. This is despite the fact that high school students in Rhode Island are required by state law to learn CPR before matriculation. This situation exists even though engineering students in the United States are generally intelligent and physically able to administer CPR. This contrasts greatly with typical results in medical and nursing professional schools.

**Methods:** A two-armed approach is currently being used in this work: a faculty committee was formed to investigate the requirement of engineering students to study laboratory safety and CPR as part of the curriculum. The second approach incorporates CPR into a technical Mobile Computing course. In addition to CPR instruction, students in this class apply virtual reality (VR) using the Google Cardboard API with Apple Xcode to implement a VR setting of emergency CPR on i-phone hardware. This enables the production of a VR experience that could also be used as a cost-effective method for layperson instruction and practice. The VR contains a 360° crowd scene with a CPR patient simulation visible at the center. Students are also working on enhancement of this VR experience.

**Results:** After significant deliberation (in which some faculty members voiced objection), CPR is now required as part of the first-year experience in laboratory safety. This will begin in the Fall Semester of 2016. The Mobile Computing class (a 4th-year and Graduate-level elective) has its highest and maximum enrollment for the Fall Semester at 16 students. Thus, students are quite excited by VR. This will enable the production of an interactive crowd scene for students to practice CPR and may also provide a significant tool for educating laypersons.

**Conclusion:** The assessment of the results of these approaches has not been rigorously performed. However, based on the excitement of using new VR tools to simulate a real-world CPR setting, the approaches may mitigate the current lack of utility in CPR by engineering students. Furthermore, the project may result in a VR system that can enhance the CPR training experience of laypersons.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.122

**AP075**

The effect of a specialized content knowledge workshop on teaching and learning Basic Life Support

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**Background:** Research investigating the effect of specialised content knowledge (SCK) on teaching and learning Basic Life Support (BLS) is almost non-existent.

**Purpose:** To investigate the effect of a SCK workshop on teacher’s enacted teaching behaviours and student learning. SCK comprises knowledge about how to teach BLS in terms of content progressions and knowledge of errors students are likely to make and how to correct these.

**Methods:** Ten elementary teachers from 3 schools were assigned to a control (*n*=4 teachers) and SCK condition (*n*=6 teachers). Teachers in the control received a BLS workshop focused on learning BLS. In addition to learning BLS, teachers in the SCK group practised the teaching of BLS focussing on skill progressions, and the recognition of common errors that children would be expected to make and how to correct these. All teachers taught one BLS lesson and their behaviour together with lesson context was collected through direct observation. Student learning was assessed 3 days following the BLS lesson by means of an individual BLS assessment.

**Results:** A total of 208 students (10 Consell Català de Ressuscitació, Barcelona, Spain) performed BLS on a Laerdal ResusciAnne manikin. Teachers’ behaviour differed as a function of the CK workshop. Teachers in the SCK group gave more feedback compared to teachers in the control (31 vs 19). Students in the SCK group spent more time practising BLS compared to the control (57% vs 30%). Students in the SCK group spent less time in listening and cognitive activities compared to the control (29% vs 55%). BLS performance of SCCK students was significantly better than the performance of their counterparts, *p* < .05.
Discussion and conclusion: The study demonstrates the impact of BLS workshops for teaching and learning. The 50-min workshop with a focus on SCK affected teacher in-class behaviour, which significantly improved student outcomes.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.123

AP076

Is it enough to watch a short ad hoc video to learn how to use an automated external defibrillator?

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Purpose: The aim of this study is to evaluate in young footballers the learning effect of viewing an ad hoc video about why and how to use an automated external defibrillator (AED).

Material and methods: A prospective, analytic and observational study that included 54 young footballers (age 12–33 years) was conducted. In phase 1 (P1) we assessed CPR knowledge by a questionnaire. After that, a video made ad hoc for this study was shared in the social media during a week. In phase 2 (P2) the sample was split in two groups of 27 subjects. G1 participants watched the video in the social media and G2 participants didn’t receive any information about AED and were considered controls. One week later, participants’ skills on AED were evaluated using a standardized test scenario.

Results: In P1, 69% of the participants reported that they know what an AED is. However, 81.5% of them acknowledged that they do not know how to use it. Seventy-four percent would try to use the AED if faced with a situation that would require it. All participants were able to perform the AED procedure in a manikin, with an average time of 85 s in G1 and 83 s in G2. Incidence of error was 50% in G1 and 62% in G2.

Conclusions: Short videos shared in social media may be useful to make the youngsters aware of the importance of recognition of cardiac arrest and also help them to know how to use an AED. Openly available and potentially viral videos may be good basic life support teaching materials, especially in young people who can share them in the social media.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.124

AP077

Effects of two teaching interventions on nursing students’ acquisition of competence in ECG interpretation

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Purpose: Nurse ability to recognise patient arrhythmias could contribute to preventing in-hospital cardiac arrest. Research suggests that nurses and nursing students lack competence in electrocardiogram (ECG) interpretation. The aim of this study was to compare the effects of two training strategies on nursing students’ acquisition of competence in ECG interpretation.

Materials and methods: A controlled randomised trial with 98 nursing students. Divided in groups of 12–16, participants were randomly allocated to one of the following 3-h teaching intervention groups: 1) traditional instructor-led (TILG), and 2) flipped classroom (FCG). Participants’ competence in ECG interpretation was measured in terms of knowledge (%), skills (%) and self-efficacy (%) using a specifically designed and previously validated toolkit at pre-test and post-test. Two-way MANOVA explored the interaction effect between ‘teaching group’ and ‘time of assessment’ and its impact on participants’ competence. Within-group differences at pre-test and post-test were explored by carrying out paired t-tests. Between-group differences at pre- and post-test were examined by performing independent t-test analysis.

Results: There was a statistically significant interaction effect between ‘teaching group’ and ‘time of assessment’ on participants’ competence in ECG interpretation ($F(3,190)=86.541$, $p<0.001$; Wilks’ $\Lambda=0.423$). At pre-test, differences in knowledge (TILG = 35.12 ± 12.07; FCG = 35.66 ± 10.66), skills (TILG = 14.05 ± 10.37; FCG = 14.82 ± 14.14), self-efficacy (TILG = 46.22 ± 23.78; FCG = 40.01 ± 21.77) and all other variables were non-significant ($p>0.05$). At post-test, knowledge (TILG = 55.12 ± 14.16; FCG = 94.2 ± 7.31), skills (TILG = 36.90 ± 16.45; FCG = 86.43 ± 14.32) and self-efficacy (TILG = 70.78 ± 14.55; FCG = 79.98 ± 10.35) had significantly improved, regardless of the training received ($p<0.05$). Nonetheless, participants in the FCG scored significantly higher than participants in the TILG in knowledge, skills and self-efficacy ($p<0.05$).

Conclusion: Flipping the classroom for teaching ECG interpretation to nursing students may be more effective than using a traditional instructor-led approach in terms of immediate acquisition of competence in terms of knowledge, skills and self-efficacy. Further research on the effects of both teaching strategies on the retention of the competence will be undertaken.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.125
Purpose: Bystander cardiopulmonary resuscitation (B-CPR) increases survival from cardiac arrest, yet B-CPR rates are low in many US communities, possibly related to insufficient training. Knowledge of the national current CPR training distribution and associated geographic variation could inform targeted training efforts. We examined the variation of CPR training within geographic divisions in the United States, hypothesizing that both increased age and income would be associated with a higher likelihood of CPR training across divisions.

Methods: We administered a survey to a nationally representative sample of individuals 18 or older. Using generalized estimating equations (logit distribution), we assessed demographic variation within divisions among individuals currently trained in CPR (within 2 years). Responses were grouped using nine pre-established US census divisions.

Results: From 09/2015–11/2015, 9,022 individuals completed the survey. In the Mid-Atlantic (p < 0.01), West North Central (p = 0.02), South Atlantic (p = 0.02) and Pacific (p < 0.01), income was associated with current CPR training. In the Mid-Atlantic, household income from $50,000–$75,000 was associated with a 3.24 (95% CI: 1.53–6.87, p < 0.01) increased likelihood of current CPR training, whereas income >$75,000 showed no association. Income >$100,000 was associated with a 4.62 (95% CI: 1.90–11.27, p < 0.01) increased likelihood of current training in the West North Central, a 2.62 (95% CI: 1.22–5.64, p = 0.01) increased likelihood in the South Atlantic and a 3.31 (95% CI: 1.48–7.39, p < 0.01) increased likelihood of current training in the Pacific. Income was not significantly associated with current training in other divisions. Within all geographic divisions, older age was associated with a lower likelihood of current CPR training (p < 0.01).

Conclusions: There is variation in the association between increased income and likelihood of current CPR training within geographic divisions. Older age was associated with a lower likelihood of CPR training across all divisions. These findings could inform future training efforts and the development of targeted B-CPR educational initiatives.
Gamified resuscitation training for secondary-school students: Results of a controlled study

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Research shows that immediate intervention of bystanders could evidently increase survival after cardiac arrest. In the Netherlands, a large number of people are trained according to the guidelines of the ERC. The Dutch Heart Foundation (DHF) aims at increasing the number of citizens who are well trained to help victims of a cardiac arrest. Following the promising results of studies about training school children, the DHF developed an online game together with game researchers and developers. The game has been played and tested at two Dutch high schools (N = 91); a third school is to follow.

At each school, several classes on different levels of education have been selected for participation in the study, based on their voluntary availability. Students were assigned to either the study group or control group by block randomization. The control group followed a traditional ERC course. The study group had access to the online game, and was able to play the game either on a computer or a mobile device at any time and any place. They were requested to accomplish the whole game at least 20 times. Access and scores could be monitored through an online portal. The week after playing the game, these students followed a revised ERC course of 2 h. A pre-course questionnaire was given to half of the gaming group (N = 37). Students of both groups received a post-test immediately after the course. The test was a simulated cardiac arrest, using a Laerdal manikin. Data of the manikin, together with observations and feedback from the Laerdal manikin, we can conclude that the game is a capable tool of knowledge transfer in the first place.

The 10 knowledge-related questions of the pre-course questionnaire showed a low rate of incorrect answers (m = 5.6), with the highest percentage of wrong responses with regard to the use of the AED (n = 10), the connection to the centralist (n = 9) and the rights to control the breathing of the victim (n = 18). Together with the observations and feedback from the Laerdal manikin, we can conclude that the game is a capable tool of knowledge transfer within an ERC course with certain limitations. The game cannot address the use of the AED in sufficient detail, as well as the correct action of how to check for breathing and to conduct chest compression. The second part of the game-based ERC course should, thus, focus strongly on practical actions, while the game can be used for knowledge transfer in the first place.

Implementation of European Resuscitation Council courses in the undergraduate curriculum at the University of Zagreb School of Medicine, Croatia

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Purpose of the study: The purpose of this study is to propose a sustainable model of how ERC courses can be implemented in the undergraduate curriculum in medical schools. The aim is to prepare young doctors for the care of acute patients (both adults and children) by developing their knowledge and practical skills from basic to advanced resuscitation courses and refreshing it on a yearly basis.

Materials and methods: In February 2013, an agreement was signed between University of Zagreb School of Medicine (UZSM) and the European Resuscitation Council (ERC). Four types of ERC courses are introduced as compulsory part of the longitudinal course “Fundamentals of clinical skills” from third to sixth year: CPR/AED (Cardiopulmonary Resuscitation and Automated External Defibrillation), ILS (Immediate Life Support), EPILS (European Paediatric Immediate Life Support) and ALS (Advanced Life Support).

Results: The CPR/AED course was completed by 346 third-year medical students in the academic year 2013/14 and 343 in 2014/15, respectively; the ILS course was completed by 287 4th year medical students in 2014/15. There are total of 976 students with ERC certificate plus currently ongoing CPR/AED and ILS courses in 2015/16. Simulation equipment was purchased by UZSM. Substantial involvement was required from UZSM administration and continuous collaboration with ERC instructors and leadership from the Croatian Resuscitation Council (CroRC). All attendees rated ERC courses with highest marks. A further plan is to run the EPILS course for fifth-year medical students and an ALS course for sixth-year medical students.

Conclusions: Introducing ERC basic and advanced resuscitation courses in the undergraduate curriculum of UZSM can result in sustainable number of medical students and young doctors who will be able to provide and teach CPR in Croatia.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.130

The CPR-workout: A new training concept

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Background: Effective resuscitation training is one of the crucial points to increase knowledge, skills and willingness to provide first aid. CrossFit is a popular fitness program consisting of aerobic exercise, body weight exercises and weightlifting. The aim of this study...
was to integrate the CPR training into a CrossFit workout program to create a positive and entertaining learning environment aiming for a higher acceptance and increased confidence to perform first aid.

Methods: After a standard warm-up, chest compressions were practised in a 15-min skill part. The following workouts were completed in teams of two. In the first part, the rescuing via rescue grip was trained along with classic fitness exercises. The time needed for the whole sequence was measured to challenge the teams. The task of the second part was to resuscitate the manikin for an average ambulance arriving time of 10 min. The team members alternated chest compressions with tuck jumps. Instructors supervised the whole workout and provided feedback. At the end of the 1-hour class, the theoretical background as well as questions of the participants were reviewed and learning goals were summarised.

Results: In this pilot course, 10 participants were trained. The mean training time at the manikin per person was 10 min. After 3 months, 9 of the 10 participants thought that they were able and willing to perform CPR on a real patient. The median confidence level (1 very insecure to 4 very confident) at this time point was 3 (IQR = 3–4).

Conclusion: The pilot course led to a high motivation and enthusiasm during the training and led to confidence to perform CPR even 3 months later. The feedback given by the trainees and trainer will be incorporated in the next courses, which will be executed and evaluated in the next months.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.131

AP084

Do medical students studying in the United Kingdom have an adequate knowledge of basic life support?


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Purpose: Healthcare professionals have a duty to maintain their basic life support (BLS) skills. The General Medical Council does not specify the amount of BLS training required for medical students. This study aims to evaluate medical students’ knowledge of BLS and whether further training is required in line with other healthcare professionals’ guidelines.

Materials and methods: Ethical approval was granted for a cross-sectional closed-response questionnaire of all UK medical schools. First- and fourth-year medical students were invited to partake in a study regarding knowledge of the BLS algorithm (in the form of 5 multiple-choice questions on BLS), previous training and their views on current BLS training in the medical school curriculum.

Results: 3732 complete responses were received from 21 UK Medical Schools. A higher number of first-year students responded, as compared to fourth-year students (2160 vs. 1572); 83% of students (n = 3081) had worked in a clinical environment in the previous 2 months, 68% (n = 2527) of students had attended BLS training outside of their curriculum whilst 80% (n = 2999) completed a course as part of their medical studies. Fewer first-year students correctly answered all 5 multiple-choice-questions (MCQs) correctly compared with fourth-year students (14% vs. 16%, p = 0.0815, n = 3732, Fisher’s Exact Test). The range varied from 2% to 53% from different medical schools. Fourth-year students scored significantly higher correct answers compared to first-year students in all MCQs except the identification of the depth of compressions during CPR; 81% of students (n = 3031) wanted more BLS training in the medical school curriculum.

Conclusions: Early and effective CPR is one of a few variables associated with improved mortality following cardiac arrest. Knowledge of BLS is poor among first- and fourth-year UK medical students. UK Medical Schools must also recognise students’ desire to receive more teaching on BLS and, therefore, the authors recommend further training should be provided.

Reference


http://dx.doi.org/10.1016/j.resuscitation.2016.07.132
Filling the voids in emergency response education: A gaps analysis

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Purpose of study: The Utstein Formula for Survival models the value of medical science as a multiplicative relationship with educational efficiency and local implementation. The Formula provides a rationale for which a positive value must be placed on each component. The 2015 International Liaison Committee on Resuscitation’s (ILCOR) Consensus on Science and Treatment Recommendations (CoSTRs) provide a starting point to analyse gaps in education at the local level, which are necessary for the Formula’s efficacy.

Method: Using the 2015 ILCOR statements as a base, a gaps analysis focuses on the local implementation of Treatment Recommendations. First the Treatment Recommendations were separated into domains of emergency response to identify gaps in a newly imagined Chain of Survival Behaviours, from the perspective of lay responders. Then, each Treatment Recommendation was reviewed for gaps. Finally, the authors and review team (made up of field-based educators) qualitatively identified gaps towards implementation which were not identified by CoSTR writers.

Results: In the 2015 CoSTRs, the domains ‘Plan & Prepare’ and ‘Recognising Emergencies’ lacked relative attention compared to the domains of ‘Respond’ and ‘Recover’ regarding the actual number of Treatment Recommendations. Moreover, at the individual CoSTR level, gaps emerge from consistently low or very low levels of evidence leading to weak or no recommendations (79%).

Conclusions: A bias towards medical science dominated the 2015 Treatment Recommendations, limiting the discussion and perhaps devaluing the educational efficiencies and discussion of local implementation. This experience may be due to the value placed on the GRADE analysis process of asking specific questions and focusing resources on specific types of evidence. For future Treatment Recommendations, more generalizable evidence to the local implementation should be available to guideline writers internationally to demonstrate the value of the Utstein Formula for Survival. Attention to fill in the voids across the domains should also be strategically addressed to support guidelines.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.133

Effects of two teaching strategies on the relationship between nursing students’ self-efficacy and performance in BLS/AED

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Purpose: Nurses and nursing students are often first responders to in-hospital cardiac arrest events; thus they are expected to perform Basic Life Support (BLS) and use an automated external defibrillator (AED) without delay. The aim of this study was to explore the relationship between nursing students’ self-efficacy and performance before and after receiving a particular training intervention in BLS/AED.

Materials and methods: Explanatory correlational study. 177 nursing students received a 4-h training session in BLS/AED after being randomized to either a self-directed (SDG) or an instructor-directed teaching group (IDG). A validated self-efficacy scale, the Cardiff Test and Laerdal SkillReporter software were used to assess students’ self-efficacy and performance in BLS/AED at pre-test, post-test and 3-month retention-test. Independent t-test analysis was performed to compare the differences between groups at pre-test. Pearson coefficient (r) was used to calculate the strength of the relationship between self-efficacy and performance in both groups at pre-test, post-test and retention-test.

Results: Independent t-tests analysis showed that there were non-significant differences (p-values > 0.05) between groups for any of the variables measured. At pre-test, results showed that correlation between self-efficacy and performance was moderate for the IDG (r = 0.53; p < 0.05) and the SDG (r = 0.48; p < 0.05). At post-test, correlation between self-efficacy and performance was much higher for the SDG (r = 0.81; p < 0.05) than for the IDG (r = 0.32; p < 0.05), which in fact was weaker than at pre-test. Finally, it was found that whereas the correlation between self-efficacy and performance increased from the post-test to the retention-test to almost reach baseline levels for the ILG (r = 0.52; p < 0.05), it slightly decreased in this phase for the SDG (r = 0.77; p < 0.05).
Conclusion: Student-directed strategies may be more effective than instructor-directed strategies at promoting self-assessment and, therefore, may help to improve and maintain the relationship between nursing student self-efficacy and actual ability to perform BLS/AED.

Reference

How does compliance with TeamGAINS affect the quality of debriefing for undergraduate inter-professional simulation?
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Purpose: Best practice simulation-based education (SBE) involves team-based scenarios with participants playing their own professional roles to improve authenticity.1 Debriefing after SBE provides an opportunity for participants to reflect on their practice.1 TeamGAINS is a six-step framework for structuring debriefs.2 The purpose of this study was to evaluate how TeamGAINS affects the quality of debriefing in undergraduate inter-professional resuscitation scenarios.

Methodology: Forty inter-professional scenarios were run for final-year nursing and medical students. Sessions were jointly debriefed by one facilitator from each course; 20 sessions were run prior to training facilitators in TeamGAINS and 20 afterwards. Debriefs were video recorded. Two independent, trained assessors, blinded to sequence, used the Debriefing Assessment for Simulation in Healthcare (DASH) rater version1 to evaluate quality. Assessors rated DASH elements on the original 7-point scale. Compliance with content and order of TeamGAINS was recorded in post-training debriefs separately. Intraclass Correlation Coefficients (ICC) for individual DASH elements and overall means were calculated to assess inter-rater reliability. Mann–Whitney U was calculated to analyse if DASH ratings improved post facilitator TeamGAINS training and the influence TeamGAINS order had on ratings.

Results: Nineteen pre- and 18 post-training debriefs were analysed. Low inter-rater reliability was observed (ICC = 0.428). Mean DASH ratings significantly improved post-training (pre: 3.97, post: 4.87, p < 0.0001). 8 variations of TeamGAINS order occurred. The most frequently used order was TeamGAINS steps 1, 2, 4, 3 and 5 (33%). Mean DASH ratings were not significantly different for debriefs that used this order compared to others (12435: 4.75, other: 4.93, p = 0.478).

Conclusions: Training facilitators in TeamGAINS improved DASH ratings of debrief quality. Debriefing may have improved as facilitators became more experienced debriefing inter-professional SBE and the sample size of this study is a recognised limitation. Further work is needed to validate debriefing frameworks.

References

http://dx.doi.org/10.1016/j.resuscitation.2016.07.136

AP089

Knowledge level in four years after completion of Cardiopulmonary Resuscitation Training Program among students attending Safety Education Classes in Polish State Schools
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Introduction: ILCOR, ERC and AHA recommend in-school CPR education as the most important strategy to improve sudden cardiac arrest (SCA) survival rate. Trials conducted in Scandinavia and USA implicate an increase in SCA survival rate after the introduction of CPR classes. Since September 2009, a Safety Education (SE) programme has been introduced in Polish junior high schools, containing at least 2 h of CPR training. Furthermore, students continuing education in high school may undertake refreshing course after 3 years. SE programme follows the ERC recommendations. Despite meeting the age criteria for CPR training enrolment (>12 years) and appropriate CPR course duration time (>2 h), the CPR in-school programme is implemented over the course of 1 year, in a 3-year-long education cycle at junior and high school levels.

Method: Pupils from Polish high schools were invited to take part in an SCA management training course. The protocol included completing an ex-ante survey and conducting an SCA scenario-based simulation. The quality of resuscitation and execution of CPR algorithm were assessed.

Results: Two hundred and thirty-five pupils were included in the study, 87 boys (37%) and 148 girls (63%). Fifty-two subjects (22.12%) took part in training outside school. One hundred and eighty-eight participants (80%) had access to a mannequin during SE classes; 138 (58.72%) did not participate in the practical part of CPR training. Average mannequin training time: junior high school 39.99 min (72.99 OD), high school 29.51 min (28.68 OD), outside school of 72.95 min (107.48 OD). The CPR algorithm 44 students (18.72%) carried out correctly, out of which 19 (35.8% p = 0.0001) had additional out-of-school CPR training. AED was used by only 4 students (1.7%). Average chest compressions rate, rescue breaths rate and chest compression depth was, respectively, 109.05/min, 4 students (1.7%). Average chest compressions rate, rescue breaths rate and chest compression depth was, respectively, 109.05/min (20.14 OD), 0.66/min (1.27 OD) and 45.99 mm (13.59 mm OD).

Conclusion: SE is a crucial element regarding its public aspect. Unfortunately, the effectiveness of CPR teaching is insufficient due to a low level of knowledge of the algorithm and the quality of resuscitation. Importantly, the use of AED protocol should be considered as a priority. Thus, the authors believe that increasing the mannequin accessibility and amount of practical training is necessary. A better result achieved by individuals trained outside school may implicate that there had been more time devoted to practical training supported by different teaching methods.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.137
AP090

The Medizinercorps Graz: A specialised education programme in prehospital emergency medicine for medical students

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Background: The Medizinercorps (MC) was founded in 1890 due to a shortage of physicians in Graz (AUT). Since then, medical students were recruited and trained in prehospital emergency medicine. After having completed an extensive additional education programme, the so-called “NKI-RM” (rescue medic with special emergency skill intubation and artificial respiration) is then enabled to perform diagnostic procedures, the most important emergency skills and other medical interventions. NKI-RM are staffing two emergency ambulance vehicles (“Jumbos”) in Graz, that have remained to be an integral part of a “Dual emergency medical care system”, which is unique in Graz.

Methods: Within the past few years, the NKI-RM training programme has been extended and optimized. A curriculum, describing the three pillars of the education programme in detail, has recently been defined. The modalities of this programme were specified and empirically evaluated. The NKI-RM training programme is covered under the Austrian Act on Ambulance Service Members of 2002.

Results: Each year, approximately 15 medical students complete their NKI-RM training programme. They receive intensive theoretical and practical education in all relevant fields of prehospital emergency medicine. The programme includes training courses and clinical electives by the Medical University of Graz, accredited training hospitals, the Red Cross and special workshops, including manikin-training, organized, and performed by the MC. The MC-specific part includes 1:1 apprenticeship, characterized by peer-assisted-learning and bedside-teaching for several month. Altogether, the programme has been extended to more than 6000 hours, during which the NKI-RM-candidate already gains practical experience. The abovementioned training modalities are proven to be of value.

Conclusion: NKI-RM are trained to perform life-saving medical emergency procedures professionally that are state of the art. In case of vague emergencies, dispatchers may send the NKI-RM staffed “Jumbo” to the emergency scene. This may prevent a high number of unnecessary call-outs of emergency physicians. In the presence of unstable vital signs, advanced life support is commenced immediately until an emergency physician arrives on scene. Thereby, it is possible to save personnel resources and costs, while guaranteeing professional patient care. People who pass this education programme have a different approach to training and education that affects their teaching of their interns and residents in further courses.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.138

AP091

The real road to the 4 H's and 4 T's: Must have BG (blood gas) analysis

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Introduction: During CPR, identification of treatable causes (H’s and T’s) is typically based on clinical suspicion and assumptions, while facts would allow a directed treatment of underlying causes. A blood gas (BG) is easy to obtain (e.g. Femoral Art. or Ven.), provides rapid objective information (i.e. hyperkalaemia – in relation to pH–, should be excluded in all patient with arrhythmias or cardiac arrest) and the BG offers an unique insight into the internal physiological state.1,2

Although, in-CPR, the use of BG is not generally practiced, we implemented it in our Institutional ACLS training as a training tool and, subsequently, into clinical practice. In our CPR protocol, a BG is done after 2-min ACLS, physically taken to the laboratory by a ‘runner’, which provides results to the team leader within 4 min. Analysis gives, besides acid–base balance, electrolyte, glucose, lactate and haemoglobin levels. ACLS training includes interpretation of BG, its impact on the H’s and T’s, and provides feedback on critical aspects in prognosis (pO2, pH). BG is repeated 10 min later.

Our objective is to stimulate and standardize use of BG during ACLS training and, therewith, in clinical practice, to eventually improve patient outcome in CPR.

Methods: In this retrospective study (January 2014 till May 2016), we analyzed how often blood gasses are used during in-hospital resuscitations in the ETZ hospital in Tilburg, (NL). Moreover, we analyzed how often critical outcomes were found impacting treatment.

Results: From January 2014 through May 2016, 94 resuscitations were documented, during which in 68 cases (72.3%) at least one BG was obtained and documented (Fig. 1).

Fig. 1. Number of cases with critical outcomes measured in blood gas during CPR.

Conclusion: BG is of value during resuscitations and in training. It is a must for H&T work-up.

References


http://dx.doi.org/10.1016/j.resuscitation.2016.07.139
Life support in the educational centres:
Teacher's training

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**Purpose of study:** Our aim is to develop the training that teachers in schools, physical education teacher ideally, need to transmit the knowledge necessary for children to complete compulsory education knowing how to act in the presence of a sudden death. All according to the curriculum in the spiral methodology.

**Material and methods:** With the help of the Life Support in Schools Working Group (comprising teachers), a training model for teachers was developed. The training methodology was adapted to the teachers’ methodology within schooling hours.

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**Results:** 315 teachers have participated in the programme. A training of 15 h was developed (combining 8 h in-class and 7 h Moodle). During this stage, they have access to the necessary resources to carry out the program, the contents learned are assessed (BLS/AED and educational method) and the platform allows them to deliver the tasks. The training plan is structured in two units:

**Conclusions:**

- The **315 teachers** have consolidated the BLS knowledge and have delivered the tasks to the platform.
- The two in-class sessions have been completed outside school hours.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.141

Teaching medical and dental students BLS/AED:
What is still missing?

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**Purpose of the study:** Timely bystander cardiopulmonary resuscitation (CPR), together with pre-hospital defibrillation, represents one of the main factors associated with increased survival rates after out-of-hospital cardiac arrest (OHCA). However, only one third of cardiac arrest victims receive prompt CPR, mostly because lack of training and impeded by fear of causing further damage, drawing an infectious disease, or providing inadequate resuscitation. Introduction of BLS/AED training during undergraduate years could lead to acquisition of these skills by the majority of the world’s population and possibly increase the likelihood of survival from OHCA. In our study, we wanted to investigate the confidence of final-year medical and dental students towards applying BLS/AED.

**Materials and methods:** A total of 137 (60%) of 227 medical and 60 (77%) of 78 dental students completed our online questionnaire from 2nd until 10th of May 2016. All students were internationally certified BLS/AED providers by the auspices of Sudan Resuscitation Council. The questionnaire consisted of demographic data and statements about perceived fears towards applying BLS/AED. Median age of medical (73% female) and dental (95% female) students was 24 years (range 21–30).

**Results:** There were no differences in perceived fears towards applying BLS/AED between medical and dental students (P = 0.132). Furthermore, no sex differences were found in relation to impeding fears toward BLS/AED employment (P = 0.164). Still, in both groups, nearly one third of students expressed the greatest worry of harming the person while performing BLS/AED.

**Conclusions:** Our study demonstrated that, even upon successfully completing the course, the majority of students still feel less confident applying BLS/AED in real life. One of the greatest fears is of doing more harm to the person in need of BLS/AED, which was expressed by both groups of students. Therefore, during future courses, we strongly suggest further demystification of potential harms complementary to BLS/AED performance.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.141

The “train as you fight” concept: Applicable for in-hospital resuscitation training?

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**Background:** Motivating caregivers for CPR and recognition of the potentially threatened patient provider and refresher courses, especially if they have a low potential exposure rate, is difficult. Solutions run from mass training to individual, computer-guided schemes. Historically, the grouping technique has primarily been on level of training (BLS, ALS) to be given. But, particularly under in-hospital conditions, ad hoc ‘teams’ (i.e. secretaries, nurses and doctors) will work together until a resuscitation team arrives when
a patient collapses. We instituted a combined multi-level, on-site training scheme to evaluate if such in-company team training (“train as you fight”) would be beneficial to teaching results.

Methods and materials: We developed a training model for combined BLS and ALS in on-site carousels, retaining few level-specific stations and adding integrating scenarios. Staff (secretaries, nurses, physicians, etc.) were allotted to groups in line with normal availability as described beforehand by their lead nurse. Materials available were tuned to be ‘as their own’. Pass/remediation/fail requirements mirrored our level specific courses. Student-to-trainer ratio was also kept unchanged at 6:1. Scenarios were altered to delay resuscitation team arrival.

Results: 6 trials were performed, particularly in out-patient (diagnostic and therapeutic) areas. Attendance (>95% of all potential candidates) was high. Trainees were secretaries, nurses, technicians, MPA/NP and physicians. All candidates passed (some after remedial, 2.5%).

Advantages seen by staff were: applicable to own experience, lowers threshold to act (100%); focused (75%); team-support (70%); offers specific opportunities for their own setting (i.e. how to deal with exam chairs, small rooms, own materials, etc. (75%). Scenarios allowed ad hoc leadership and use of their own equipment, with sometimes surprising outcomes. Management was particularly satisfied with the efficiency. Most challenges were for the instructors (assuring level-specific training goals, skill station management, strange training environment, etc.).

Conclusion: Mixed BLS and ALS (including scenario) training on location are highly effective and satisfactory. Advantages are: all personnel can be trained in a brief timeframe, approaches staff comfort zone and ensures team training as well as teambuilding. This strategy can motivate otherwise difficult-to-reach in-hospital staff.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.142

AP095

Video-based compression-only CPR teaching: A feasible and effective way to spread CPR in secondary schools

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Purpose of the study: To assess feasibility and effectiveness of a video-based only CPR training program in schools performed by physical education (PE) teachers not certified as CPR instructors.

Material and methods: We supplied a secondary school with a Compression Only CPR (CO-CPR) training kit made up of an educational DVD and 10 inflatable manikins (Laerdal MiniAnne Plus).

The educational DVD comprised 3 sessions: motivational session, CO-CPR instructions and demonstration, learning by watching video.

The course was administered to 36 students (17 males and 19 females, 17.3 ± 1.5 years old) of a secondary school by two CPR/AED certified PE teachers that had never followed any type of CPR instructor course. At the end of the course, we assessed knowledge about resuscitation with a questionnaire and we recorded 1-min CO-CPR with a skill evaluator manikin (Laerdal ResusciAnne QCPR with Skillreporter software) for each students measuring mean compression depth (Cdepth), mean compression rate (Crate), percentage of correctly released compressions (Crel%) and percentage of compressions with correct hand position (Chand%).

Results: Questionnaire results show that 100% of students know when to perform chest compressions and when to call EMS, 98% how to evaluate if a person has a cardiac arrest; 96% know the correct BLS sequence (check safety – check consciousness and breath – call EMS – start CO-CPR); 92% know the right chest compression depth and rate. During the practice assessment, we found a median C depth of 45.5 mm (95%CI, 40.3–50.3), a median Crate of 118 cpm (95%CI, 113.7–127), a median Chand% of 100% (95%CI, 100–100) and a median Crel% of 90% (95%CI, 74.3–97).

Conclusions: Our study shows that video-based only CO-CPR training in schools may be feasible and effective with rather good performance results. However, it is reasonable to consider that a short instructor course for teachers could improve students CPR quality.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.143

AP096

Is our assessment of resuscitation skills robust? Examining the validation process

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Purpose: Just as a chain is only as strong as its weakest link, so too is assessment only as robust as the tool used to examine performance. We sought to assess paramedic students insert a laryngeal mask airway (LMA) and intraosseous (IO) device in a simulated setting in a randomised controlled trial. We searched the literature for validated assessment tools for these two skills, and after finding none suitable to this context, we developed one.

Methods: We invited expert pre-hospital clinicians (retrievalists and intensive care paramedics) to participate in a modified Delphi study1 to investigate expert consensus for LMA and IO application in the pre-hospital setting. Two rounds of data collection were performed.

Results: Using this procedure as reported in the literature, consensus was achieved for IO (Cronbach’s α = 0.725) but not for LMA (Cronbach’s α = 0.494).

Conclusions: A critique of the Delphi method challenges (1) Cronbach’s α as the accepted coefficient2 in reporting data agreement, (2) the current understanding of “consensus”, (3) whether a Delphi method is the best approach to determine consensus for all types of skills, and (4) the task of validation as a single, finite activity.3

References

AP098

How effective is blended learning for first aid education?

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Purpose of the study: Blended approaches to learning have been shown to be effective in educational and medical settings, but evidence about their effectiveness for first aid is sparse. To explore this issue, we undertook a study to compare the educational effectiveness of a blended learning approach to a traditional face-to-face approach. We measured effectiveness in terms of knowledge and confidence.

Materials and methods: A control-and-experimental group approach was adopted. The control group received a 4-h, face-to-face first aid course and the experimental group spent 1.5 h following a bespoke online learning experience in their own time, followed by 2.5 h on a face-to-face course. One hundred learners participated and first aid confidence and knowledge were assessed pre- and post-learning. Focus groups provided qualitative data.

Results: Both blended and face-to-face learning pathways were effective at increasing first aid confidence and knowledge. The face-to-face learning pathway brought greater increases to learners' confidence in six first aid skills. The blended pathway resulted in greater increases in learners' confidence across seven first aid skills including CPR, head injury, stroke and broken bones. Blended learning gave greater increases in learner knowledge in four skills. Face-to-face learning saw bigger increases in knowledge across nine skills including CPR, head injury and broken bones.

Conclusions: Our results showed that blended learning was more effective at increasing learner confidence and face-to-face learning was more effective at increasing knowledge. The overall results for blended learning support it as an educational methodology for first aid but skills analysis showed future research should focus on identifying the best 'blend' of skills to be delivered through this approach to maximise knowledge as well as confidence.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.145

AP099

Teaching CPR and first aid using blended learning: Experiences from a novel academic course at a medical university

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Purpose of the study: This study sought to evaluate whether First Aid and CPR can and should be taught in a semi-virtualised course system ( coined "Blended Learning" ).

Materials and methods: Lectures in First Aid and CPR for first-year medical students at our institution were redesigned in 2015. Only half the lectures and trainings required student's attendance, whereas the rest could be completed in the university's virtual learning environment. Students were asked for their feedback after completion of the course.

Results: 324 students originally enrolled for the course; 210 students completed the feedback – which was anonymous and voluntary – resulting in a return rate of 65%. Out of these, 181 (86%) would prefer the course to further utilise Blended Learning in the future. Available lectures were completed once by 77 (37%), between two and five times by 127 (60%) and more than five times by 6 (3%) students; 49 (23%) students would re-visit the lectures later in their studies "very likely", 112 (53%) would do so "likely". When asked whether more courses should use the "Blended Learning" style, 40 (19%) absolutely agreed, 50 (24%) strongly agreed and 60 (29%) agreed. All students who completed all lectures and trainings passed the course and its final examination successfully.

Conclusions: The concept of “Blended Learning” in an academic First Aid and CPR course is regarded as useful by a vast majority of participants. The large number of students completing lectures more than once during the course and considering taking virtual lectures again later on may be considered proof of the concept's sustainability. Creating and providing virtual lectures and trainings is strenuous for staff and infrastructure at first but may reduce long-term cost and staff requirements.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.146
average points improved from pre-training 25.9 (61.6%) to 39.1 (93.0%) post-training ($p < 0.001$) referring to the possible reachable number of 42 (100%) points. An improvement ($p < 0.05$) of the arithmetic mean of all occupational groups was shown. Participants reported a high level of perceived benefit.

**Conclusions:** After taking part in the NLS course, participant skills increased significantly. This improvement of skills was also reflected in the perception of the participants. It needs to be evaluated in further investigations how long skills will be retained.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.147

**AP100**

**Telephone-CPR family training facilitated by 7th graders**

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**Purpose:** To evaluate if a 7th grade class can facilitate a standardized video-based telephone-CPR (T-CPR) course for their families.

**Material and methods:** T-CPR courses were performed as a cascade starting with training the teachers, who trained the 7th graders, who trained their families.

Two elementary schools, six 7th grade classes and, in total, 140 students were included in this pilot.

Before facilitating the family course, the students received a detailed instruction guide and were assigned different roles which they practiced.

A validated T-CPR course model was used. After 30 min of manikin (1:1) skill training with video instruction and 15 min of simulation, the participants were invited to report important learning through the written assignment “two stars and a wish.”

We expected the participants to report in compliance with main learning objectives specified for the T-CPR course, indicating that the 7th graders can facilitate a standardized training.

**Results:** In this pilot, 137 7th graders recruited and trained 96 parents in T-CPR in Oslo and Stavanger. In addition, 37 teachers were trained.

The 96 parents reported 192 important learnings distributed in the following categories, about: performing good chest compressions ($n = 68$); caller – dispatcher teamwork ($n = 56$); signs of cardiac arrest ($n = 13$); importance of helping a person with signs of cardiac arrest ($n = 12$); continuing CPR until professionals take over ($n = 9$); opening airways and checking for breathing ($n = 8$); the need for CPR for a person with signs of cardiac arrest ($n = 8$) and Other ($n = 18$).

The first three, reported by 90 out of 96 parents, are in compliance with main learning objectives specified for the course.

**Conclusion:** Family training in T-CPR facilitated by 7th grade students is feasible; 94% of the participants reported learning in agreement with the main course objectives.

**Reference**


http://dx.doi.org/10.1016/j.resuscitation.2016.07.148

**AP101**

**Knowledge and attitudes concerning ‘in case of emergency’ telephone number among medical students**

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**Purpose of the study:** During an accident, emergency services often encounter problems with notifying the victims’ relatives of the ensued event. In order to facilitate the contact with a relative in case of an accident, the cellular phone should have a special number marked as ‘ICE’ – in case of emergency. In this way, the rescue personnel can find the appropriate number without searching the entire telephone number list. The aim of the study was to assess the knowledge and attitudes concerning the ICE number among medical students.

**Materials and methods:** A questionnaire was sent out by e-mail to final-year medical students of Polish universities. The survey was carried out with the use of a popular on-line survey tool. Out of 450 questionnaires, 260 (57.8%) were completed and analysed.

**Results:** Among the 260 participants, 49.2% were male; 50.8% of respondents (45.5% male vs. 54.5% female) knew what the ‘ICE’ abbreviation stood for. However, only one third of those had entered the number in their cellular phones. The respondents pointed at the Internet (63.6%), followed by family and friends (21.2%), the university (12.2%) and television (3.0%) as the main source of knowledge about the ICE number. All the respondents declared that they would enter the ICE number in their telephones.

**Conclusion:** The social awareness regarding the number of ICE should be increased in order to obtain its advantages during the management of victims and their families.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.149

**AP102**

**A statistical study on cardiopulmonary resuscitation learning in Italy**

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**Purpose of the study:** One year after publication of 2015 guidelines, our attention focuses on educational aspects of cardiopulmonary resuscitation (CPR). This study aims to evaluate the quality of CPR training, examining some crucial variables for basic life support (BLS). If any critical issues were identified in the learning process, new educational approaches could be developed.

**Materials and methods:** During the final months of 2015, BLS courses were held according to guidelines and 150 laypersons (age: 18–65, median = 25; $M/F = 1/2$) were enrolled. All participants completed a pre-test, composed of 7 questions on BLS. After lessons, the same test was administered (post-test). Practical work was conducted on a Resusc–Annie manikin with a training defibrillator. Finally, instructors used the skill test form by Italian Resuscitation Council to evaluate practical abilities. The 16 items were grouped into 4 categories (A: Airways; B: Breathing; C: Circulation; D: Defibrillation). The $k$ statistical program was used for analysis.

**Results:** Median pre-test, post-test and skill test scores were 4 (range: 0–7), 7 (range: 3–7) and 14 (range: 8–16). Significant
differences exist between sex and pre/post-test scores, but not skill test scores (Mann–Whitney–Wilcoxon test, \( p \)-value = 0.013, 0.007 and 0.11, respectively). Men rather than women attended previous courses (chi-square test, \( p \)-value = 0.0004). Inverse correlations were found between age and all scores (Spearman’s correlation, \( p \)-values < 0.01). Regarding skill test, age is related to group A abilities only, regarding the approach to airways (\( p \)-value = 7.44e−05). Skill test shows no correlation with post-test (\( p \)-value = 0.08), unlike pre-test (\( p \)-value = 0.0001).

**Conclusions:** CPR courses significantly improve theoretical knowledge and practical abilities. Higher scores in men primarily depend on their greater interest. Efforts should be made to sensitize women and people in later years to CPR. The latter should exercise especially in checking and supporting airways. Previous courses always increase scores, underscoring the importance of retraining. Written evaluation of knowledge is not a predictor of practice and theory is no guarantee of abilities.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.150

**AP103**

**The development of the European Trauma Course in Austria: Data on 30 courses**

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**Introduction:** Worldwide, trauma claims more productive life years than any other disease. The World Health Organization estimates that the mortality of major trauma in Europe could be decreased up to 30% by improving the chain of care for major trauma patients. In recent years, different trauma teaching programmes have been established in working towards decreasing the burden of death and disability of traumatized patients. European Trauma Course (ETC) goal is to teach a simplified and standardised approach to trauma patient management. ETC was designed in collaboration with the ERC, EuSEM, ESTES and ESA. Austrian group of experts in trauma patient management and the Austrian societies joined ETC initiative from the early beginning, being the first group providing in-house courses, prehospital and in-hospital scenarios, interactive presentations for instructors and pushing the topics of human factors in the courses.

**Material and methods:** Database search of the records of ETC Austria from 2008 until April 2015.

**Results:** Thirty courses were completed, with 669 participants (199 females, 470 males). More than two thirds of participants were doctors (627), followed by nursing staff (22) and ambulance personnel (20). The majority of participants were anaesthesiologists (323), alongside with trauma surgeons (232), emergency medicine specialists (82) and others (33). Of these 30 courses, 20 were open ones with individual registration and 10 were closed in-house courses for single institution trauma teams training.

**Conclusion:** In the past 6 years, ETC has become the standard trauma course in Austria. Every year, more and more medical personnel from nursing and ambulances join our courses, building the whole concept closer towards ETC goal of multi-specialty and multi-professional trauma team approach.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.151

**AP104**

**Italian Resuscitation Council: When the “Viva! week” feat the “Kids Save Lives” campaign**

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**Purpose of the study:** Since 2012, the Italian Resuscitation Council (IRC) has been improving cardiac arrest awareness with the “Viva!” week (http://www.settimanaviva.it). In January 2015, several scientific societies, including the European Resuscitation Council (ERC), developed the “Kids Save Lives” (KSL) statement to train schoolchildren in CPR worldwide, under the auspices of the World Health Organization. KSL campaign became the main target of the Viva! week.

**Methods:** KSL campaign was advertised using the Viva! week tools and social networks. Ministry of Health (MH) and Education (ME) were contacted to call for CPR teaching to be mandatory in the primary and secondary school. An editorial agency (Elastico Srl, http://www.elasticoapp.com/index.html) was recruited to develop specific teaching material for primary school kids. Concurrently, the serious game RELIVE, for secondary school students, was completed and released free on steam platform (http://store.steampowered.com/app/404580 – Fig. A).

**Results:** An official logo for the KSL campaign was created (Fig. B) and was formally adopted by ERC (https://www.erc.edu/index.php/doclibrary/en/viewDoc/2203/3/). On 13 July 2015, a new law was amended which introduced mandatory teaching of first-aid maneuvers in primary and secondary schools (art.1, comma10, law no.107). Concurrently, IRC organized a CPR mass training for kids in front of the governmental palace in Rome (Fig. C). During the year, several events have been organized by IRC in the schools and a mass training took place in Milan during the 2015 Viva! week, in which 5,000 secondary school students were certified as BLSD providers (Fig. D). IRC developed a free downloadable package for teachers, tuned on the school grade (http://www.ircouncil.it/progettoscuola/). Finally, the free downloadable interactive e-tale for secondary school students, was completed and released free on steam platform (http://store.steampowered.com/app/404580 – Fig. A).

**Conclusions:** Teaching CPR maneuvers to kids can boost CPR awareness.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.152
As a result of the review, a new AED training programme was instigated focused on the things that make a difference in real-life events with the majority of the focused training time spent hands on to instil confidence and competence of would be rescuers. The programme was launched in January 2011 with 100 trainers being updated and 1750 team members being trained in the new programme.

To evaluate the effectiveness of the new training programme, a study was undertaken to review cardiac arrests that occurred over a 5-year period from 2011 to 2015. The study was undertaken by reviewing detailed incident reports that were compiled following each cardiac arrest, AED download data and patient follow up notes. In all incidents, casualties were attended to by at least two team members trained in CPR and AED and the AED electrodes were placed on the casualty’s chest rapidly.

During the 5-year period, team members attended to 43 OHCA, with 37 casualties surviving to hospital discharge generating an overall survival rate of 86%. Survival rates peaked in 2014, with team members providing immediate assistance to 6 casualties in cardiac arrest with all 6 surviving to hospital discharge.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.153

AP106

Are 8–13-year-old schoolchildren too young for resuscitation training? A randomized controlled trial

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Purpose: The WHO, ERC and AHA emphasize the importance of resuscitation training in school. However, due to the lack of evidence, teaching chest compression skills is limited to children who are 13 years or older. Therefore, we examined the impact of age on motivation and interest in resuscitation training in children.

Methods: Children 8–13 years old were included in a randomized, single-blind controlled trial. All children received 40 minutes of resuscitation training in small groups. We used two optically identical resuscitation manikins with different thoracic resistances: control group (CG) with standard resistance (45 kg), intervention group (IG) with lower resistance (30 kg). Children were not informed about the existence of two different resistances. After training, we assessed each child with a questionnaire. The questionnaire with four possible answers assessed enjoyment and motivation.

Results: Of 322 participants, 164 were assigned to the IG and 158 to the CG. The mean age was 10.1 ± 1.4 years in the IG and 10.5 ± 1.5 years in the CG (p = 0.19). There was no significant between-group difference in any of the items; 98% of the participants in the IG and 99% in the CG had fun (p = 0.32). Glad to train again in the future were 89% in the IG and 91% in the CG (p = 0.89); 99% in the IG and 98% in the CG (p = 0.65) were interested in the training. For the whole sample, it was important to know how to help in case of emergency (p = 0.81). There were no significant interactions with age.

Conclusions: The results show very high acceptance of resuscitation training in schoolchildren and support the concept of an early resuscitation training.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.154

AP107

Students’ knowledge of automated external defibrillators

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Purpose of the study: Starting cardiopulmonary resuscitation (CPR) in out-of-hospital cardiac arrest (OHCA) by bystanders is an important survival predictor. Most ECG rhythms in adult OHCA are shockable, including ventricular fibrillation. Automated external defibrillator (AED) usage substantially affects CPR effectiveness. The study aimed at evaluating student knowledge on AED use.

Materials and methods: A questionnaire was distributed among students of several universities in Wroclaw, Poland. The study involved 226 students (mean age, 22.1 ± 1.9 years); 38.1% (n = 86) were medical students (control group) and 61.9% were non-medical students (study group).

Results: Participation in an AED training during the past year was declared by 37.8% in the study group and 83.7% in the control group; 6.9% vs. 7.1% in every unconscious patient (p = .39), 53.5% vs. 57.1% in every unconscious patient with abnormal breathing (p = .02), 53.5% vs. 57.1% in every unconscious patient with no pulse on large arteries (p = .64) and 6.9% vs. 7.1% in every patient with suspected myocardial infarction (p = .23). Asked about the percentage of survival in OHCA with properly performed CPR and AED application within 3–5 min from OHCA occurrence, 61.6% of the control group and 37.8% of the study group correctly indicated 50–70%, 25.6% vs. 36.4% pointed at over 70%, and 8.1% vs. 14.3% reported 31–50%.

Conclusions: Student knowledge of AED use is high but should be increased, especially in medical faculties.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.155

AP108

Withdrawn

http://dx.doi.org/10.1016/j.resuscitation.2016.07.156
100% survival for OHCA victims with shockable rhythm if AED was used by laypeople: Data from Pavia CARE

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Purpose: It has been widely demonstrated how the use of AED by laypeople improves survival after an out-of-hospital cardiac arrest (OHCA) and 2015 guidelines highlighted that the use of AED by laypeople without any training is safe and efficacy. In Italy, however, there is a low spread of AED in public places and, according to Italian law, a layperson needs a certificate to use an AED. The aim of our study was to verify if the use of AED before the arrival of EMS improved the survival at 1 month with good neurological outcome (CPC 1–2) in the province of Pavia.

Methods: Using data of the cardiac arrest registry of the Province of Pavia (Pavia CARE), we considered all the patients who suffered an OHCA between October 2014 and December 2015 who received bystander CPR and whose first rhythm was a shockable one, excluding the OHCA witnessed by EMS. In this group, we compared patients who received the first shock by EMS personnel (group EMS) and the patients who received the first shock by laypeople (group PAD).

Results: The group EMS consisted of 44 patents (84% male, mean age 65 ± 19 years), whilst the group PAD of 4 patients (100% males, 66 ± 14 years). There was a statistically significant difference for 1 month survival with good neurological outcome (20.4% in group EMS vs 100% in group PAD, p < 0.01).

Conclusions: All patients who received the first shock by AED used by laypeople survived with good neurological outcome after 1 month, with an increase of 5 times with regard to the patients shocked by the EMS. Our evidence support the spread of AED in Italy and a revision of Italian law to allow all laypeople to use an AED even without training to increase the number of patients shocked by bystanders.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.157

One-year survival and quality of life after out-of-hospital cardiac arrest in the city of Ulm (Germany)

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Purpose: Assessing outcome of out-of-hospital cardiac arrests (OHCA) and quality of life 1 year after cardiac arrest in the city of Ulm (Germany).

Materials/methods: The emergency medical service (EMS) in Ulm consists of paramedic crews and physician-staffed vehicles. Data on all cardiac arrests from 11/2005 to 12/2011 were analyzed.

Quality of life 1 year post-arrest was recorded using the Euroqol-EQ-5D-3L-VAS-questionnaire.

Results: A total of 683 CPRs following confirmed OHCA were investigated. Survival-to-hospital-admission was 297 (43%), survival-to-hospital-discharge was seen in 119 (17%) and 14% were still alive one year post-arrest. Mean age was 67.5 ± 16.9 (SD), 446 males (65%), the majority of patients collapsed at home 425 (62%), followed by public places 163 (24%). Of the 683 OHCA cases, 477 (70%) were of presumed cardiac aetiology, 183 (27%) had an initial shockable rhythm, half of the patients showed asystole 346 (51%). Odds of survival-to-discharge were 6.1 (CI 4.2–8.9) times higher [8.2 (CI 5.3–12.8) times for 1-year-survival] when the patient presented a shockable rhythm. Collapse was bystander-witnessed in 397 (58%) cases [survival-to-hospital-discharge 21%: RR 2.2 (CI 1.5–3.2), 1-year-survival 18%: RR 2.0 (CI 1.3–3.1)] and 215 (33%) received bystander CPR. Mean time to CPR-initiation was 8 min. ROSC before admission occurred in 269 (39%), of 95 OHCA survivors, 38 responded to the questionnaire. Mean EQ-5D score was 0.84 ± 0.3 (SD). No problems at all were reported by 40% of the responders. Problems were: pain (43%), anxiety (36%), impairment of daily activity (35%), mobility (24%) and self-care (19%). Mean QOL-VAS score was 70.2 ± 26.9 (SD); over one third reported a score >80 (36%).

Conclusions: Survival following OHCA in Ulm is high. Patients who survived 1 year post-arrest present an acceptable to good quality of life.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.158

Survival after out-of-hospital cardiac arrest victims in urban, semi-urban and rural municipalities

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2 Stavanger University Hospital, Stavanger, Norway

Background: Out-of-hospital cardiac arrest (OHCA) is a major health challenge. To achieve return of spontaneous circulation (ROSC), cardiopulmonary resuscitation (CPR) and early medical intervention is essential. Thus, remote OHCA incidents represent a time-critical challenge for the Emergency Medical Services (EMS). The aim of this study was to measure the association for survival after OHCA in Norwegian urban, semi-urban and rural municipalities.

Methods: Data were retrieved from the local OHCA registry containing all OHCA of cardiac cause patients from 18 different municipalitis in the South of Rogaland, Norway, in the years from 2006 to 2014. The study area covers a population of approximately 360,000 inhabitants served by one dispatch center and one cardiac arrest centre. For the purpose of the study, the municipalities were divided into urban (>15,000 inhabitants), semi-urban (between 15,000 and 4000 inhabitants) and rural (<4000 inhabitants) categories. Moreover, we collected data about patient age, witnessed vs. non-witnessed cardiac arrest and shockable or non-shockable rhythm. Outcome was measured as survival to hospital discharge. We used the chi-square test for statistical analysis.

Results: Over the study period, 1345 cases of OHCA with presumed cardiac origin were reported. Resuscitation was initiated and/or continued by the EMS in 1030 cases. Median age was similar in the urban, semi-urban and rural municipalities. The initial rhythm was shockable for 435 patients (41.8%). Bystanders
witnessed 57.4% and EMS witnessed 10.9%. Survival to hospital discharge was higher in urban areas compared to semi-urban and rural areas.

Conclusions: We found significant differences in survival to hospital discharge for OHCA in urban, compared to semi-urban and rural, municipalities.

<table>
<thead>
<tr>
<th></th>
<th>Urban</th>
<th>Semi-urban</th>
<th>Rural</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>No.</td>
<td>799</td>
<td>155</td>
<td>85</td>
<td></td>
</tr>
<tr>
<td>Age (median)</td>
<td>70</td>
<td>71</td>
<td>73</td>
<td></td>
</tr>
<tr>
<td>Witnessed</td>
<td>80(56.6%)</td>
<td>87(56.9%)</td>
<td>55(65.5%)</td>
<td>0.232</td>
</tr>
<tr>
<td>-bystander</td>
<td>450(56.6%)</td>
<td>87(56.9%)</td>
<td>55(65.5%)</td>
<td></td>
</tr>
<tr>
<td>-EMS</td>
<td>82(10.3%)</td>
<td>19(12.4%)</td>
<td>12(14.3%)</td>
<td></td>
</tr>
<tr>
<td>Shockable rhythm</td>
<td>347(43.4%)</td>
<td>57(36.8%)</td>
<td>31(36.4%)</td>
<td>0.07</td>
</tr>
<tr>
<td>Survival to hospital discharge</td>
<td>187(23.6%)</td>
<td>21(13.8%)</td>
<td>15(17.9%)</td>
<td>0.02</td>
</tr>
</tbody>
</table>

http://dx.doi.org/10.1016/j.resuscitation.2016.07.159

AP112

Lack of significant circadian variations of survival after all witnessed out-of-hospital cardiac arrests (OHCA) having prehospital return of spontaneous circulation (ROSC) and the OHCA witnessed by emergency medical service (EMS)

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2 Nanao General Hospital, Nanao, Ishikawa, Japan
3 Ishikawa Prefectural Hospital, Kanazawa, Ishikawa, Japan

Background and Aim: Survival from OHCA and in-hospital cardiac arrests shows a variation associated with time of day. Decreased quality of in-hospital post-resuscitation care has been proposed as one of causes of this variation. This study aimed to clarify whether those variations of survival from OHCA may differ between bystander-witnessed and EMS-witnessed OHCA or between the witnessed OHCA with and without prehospital ROSC.

Methods: From prospective, nationwide, population-based registry during the period of 2007–2013 in Japan, we extracted and analysed the data for 227,524 bystander-witnessed OHCA without prehospital involvement of physicians, having a complete dataset for analysis.

Results: For all witnessed OHCA, we confirmed the noticeable variation of survival associated with time of day, which is significant even when the survival rates were adjusted for other backgrounds of OHCA using multivariable analysis: 5.5% during daytime (9:00 am to 5:00 pm) and 4.4% during the other time of day, adjusted OR: 95% CI, 1.36; 1.30–1.42. Sensitivity of DA-CPR (DA-CPR rate in cases that did not receive bystander-initiated CPR without DA-CPR) during day-time was slightly lower than that during non-daytime occurrences: 25.1% and 25.5%, respectively, 0.91; 0.89–0.93. The acceptance rate of DA-CPR did not significantly vary, whereas the degree of bystander’s own activity for CPR had a circadian variation that is very similar to the survival rate. Difference in the overall rates of bystander CPR between daytime and non-daytime was very small: 4.7% and 4.6%, 1.04; 1.03–1.06. However, there were relatively large differences in the rates of bystander-initiated CPR without DA-CPR by day-time: 18.4% during daytime and 14.4% during non-daytime: unadjusted OR; 95% CI, 1.34; 1.31–1.37 and bystander-performed defibrillation using an automated defibrillator (2.2% during daytime and 1.0% during non-daytime: 2.29; 2.14–2.46).

Conclusions: Presumably due to shift of well-trained bystanders from working and public places to their residences, the incidence of bystander-initiated CPR without DA-CPR decreased during non-daytime hours. The community-based recruitments of well-trained bystanders and 24-hour civil service workers during non-daytime hours are necessary to diminish the circadian variation of survival from OHCA.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.160

AP113

Circadian variations of parameters associated with dispatcher-assisted cardiopulmonary resuscitation (DA-CPR) and bystander CPR: Low incidence of bystander-initiated CPR without DA-CPR during non-daytime

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2 Ishikawa Prefectural Hospital, Kanazawa, Ishikawa, Japan
3 Noto General Hospital, Nanao, Ishikawa, Japan

Aim: Circadian variations of survival from out-of-hospital cardiac arrest (OHCA) may be attributable to prehospital factors before emergency medical service arrival at patients. This study aimed to clarify the chronological changes in parameters associated with DA-CPR and bystanders CPR and their relations to the circadian variations of survival.

Methods: From prospective, nationwide, population-based registry during the period of 2007–2013 in Japan, we extracted and analysed the data for 227,524 bystander-witnessed OHCA without prehospital involvement of physicians, having complete dataset for analysis.

Results: Survival from bystander-witnessed OHCA was significantly associated with time of day but not with weekends and holidays. The survival rates were 4.8% during daytime (9:00 am to 5:00 pm) and 3.6% during non-daytime: unadjusted OR; 95% CI, 1.36; 1.30–1.42. Sensitivity of DA-CPR (DA-CPR rate in cases that did not receive bystander-initiated CPR without DA-CPR) during day-time was slightly lower than that during non-daytime occurrences: 25.9% and 25.3%, respectively, 0.91; 0.89–0.93. The acceptance rate of DA-CPR did not significantly vary, whereas the degree of bystander’s own activity for CPR had a circadian variation that is very similar to the survival rate. Difference in the overall rates of bystander CPR between daytime and non-daytime was very small: 47.8% and 46.7%, 1.04; 1.03–1.06. However, there were relatively large differences in the rates of bystander-initiated CPR without DA-CPR by day-time: 18.4% during daytime and 14.4% during non-daytime: 1.34; 1.31–1.37 and bystander-performed defibrillation using an automated defibrillator (2.2% during daytime and 1.0% during non-daytime: 2.29; 2.14–2.46).

Conclusions: Presumably due to shift of well-trained bystanders from working and public places to their residences, the incidence of bystander-initiated CPR without DA-CPR decreased during non-daytime hours. The community-based recruitments of well-trained bystanders and 24-hour civil service workers during non-daytime hours are necessary to diminish the circadian variation of survival from OHCA.
AP114

Return of Spontaneous Circulation (ROSC) in Out-of Hospital Cardiac Arrest (OHCA) and type of bystanders (lay/health personnel): The 2015 analysis of the provincial “Out-of-Hospital Cardiac Arrest Registry” of the emergency medical system “Trentino Emergenza” in the Autonomous Province of Trento (Italy)

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1 Emergency Department, Health Care Trust of the Autonomous Province of Trento, Italy
2 Service of Clinical Epidemiology, Health Care Trust of the Autonomous Province of Trento, Italy

Purpose of the study: The study aimed to prove that the probability of ROSC is higher in cases where CPR maneuvers are provided by a bystander-type healthcare professional than a layman.

Materials and methods: We included in the study all cases of out-of hospital cardiac arrest recorded in our dedicated provincial registry according to the Utstein style for the year 2015. We used a chi-square to analyze the association between the type of witness and ROSC.

Results: During 2015, there were 273 cases of OHCA and we selected 213 (78%) cases witnessed by a bystander. Data related to cardiac arrests show that there is a statistically significant association between the type of bystander and ROSC. The results show that cases of hospitalization are more numerous when the CPR maneuvers are performed by healthcare personnel; chi-square = 6.99, df 1, p = 0.0082. We also noted that the median age of the patients managed by healthcare personnel was higher than the median age of the patients managed by laypersons (79 years vs. 69 years).

Conclusions: The presence of a trained witness, such as an emergency healthcare professional, able to provide valid and effective CPR maneuvers, increases the probability of ROSC. This result is confirmed by the age of patients managed by healthcare group.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.162

AP115

Variables that influence the discharged alive in the Out-of Hospital Cardiac Arrest (OHCA): Analysis of the cardiac arrest registry data of the Autonomous Province of Trento (Italy) for the year 2015

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1 Emergency Department, Health Care Trust of the Autonomous Province of Trento, Italy
2 Information Systems Service, Health Care Trust of the Autonomous Province of Trento, Italy
3 Service of Clinical Epidemiology, Health Care Trust of the Autonomous Province of Trento, Italy

Purpose of the study: Identify variables that determine the rate of being discharged alive of patients with Out-of Hospital Cardiac Arrests.

Materials and methods: This study includes all cases of OHCA, recorded in 2015 in the dedicated Utstein style provincial registry. We used multivariate logistic regression analysis, odds ratio (OR) and associated 95% confidence intervals (CIs). The discrimination of the model is evaluated with the area under the ROC curve (or c) statistic.

Results: During 2015 were 273 OHCA, crude rate 5.1 × 10.000 inhabitants and the number discharged alive were 48 (17.6%). Multivariate logistic regression analysis showed that the variables mainly related to being discharged alive are, age (OR 0.962, CI 0.94–0.99), type of unknown bystander vs healthcare (OR 0.134, CI 0.03–0.59), asystole vs FV/TV (OR 0.03, CI 0.01–0.08), and PEA vs. FV/TV (OR 0.019, CI 0.001–0.11). The c statistic = 0.9, indicating a good discrimination of the model.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Unadjusted</th>
<th>Adjusted</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OR</td>
<td>95% CI</td>
</tr>
<tr>
<td>Sex</td>
<td>0.425</td>
<td>0.18–0.91</td>
</tr>
<tr>
<td>Age</td>
<td>0.983</td>
<td>0.97–1</td>
</tr>
<tr>
<td>Rovereto district vs Trento district</td>
<td>0.848</td>
<td>0.3–2.23</td>
</tr>
<tr>
<td>rest of province vs Trento district</td>
<td>0.788</td>
<td>0.39–1.62</td>
</tr>
<tr>
<td>Lay vs Healthcare</td>
<td>0.674</td>
<td>0.31–1.58</td>
</tr>
<tr>
<td>Unknown bystander vs Healthcare</td>
<td>0.269</td>
<td>0.08–0.83</td>
</tr>
<tr>
<td>Asystole vs FV/TV</td>
<td>0.041</td>
<td>0.01–0.1</td>
</tr>
<tr>
<td>PEA vs FV/TV</td>
<td>0.036</td>
<td>0.0–0.18</td>
</tr>
<tr>
<td>Unknown aetiology vs cardiac</td>
<td>0.885</td>
<td>0.44–1.73</td>
</tr>
<tr>
<td>Trauma aetiology vs cardiac</td>
<td>1.726</td>
<td>0.39–3.53</td>
</tr>
</tbody>
</table>

Conclusions: The analysis of OHCA registry data allows the main variables associated with a positive outcome of the patients to be detected.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.163
Neurological outcome after telephone CPR in a rural EMS system

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2 Diakoniekrankenhaus, Flensburg, Germany

Purpose of the study: Based on data from urban EMS systems in North America and Europe, ERC guidelines 2010 and 2015 advocate telephone CPR (T-CPR) as a means of improving survival after OHCA [1,2]. Data from rural EMS systems is not available so far.

Materials and methods: Retrospective analysis of dispatch, EMS and hospital protocols from Harrislee Communications Centre serving a population of 515,000 in rural Northern Germany. Primary end point was survival at hospital discharge with favourable neurological outcome (CPC 1 + 2) in 2010 before implementation versus 2011 when T-CPR was introduced.

Results: A total of 788 patient records were available for analysis: n = 315 without T-CPR (2010), n = 336 without T-CPR (2011), n = 137 with T-CPR (2011). Demographic data and EMS arrival times did not differ significantly between groups. T-CPR rate was 29.0%. Survival with favourable neurological outcome was significantly higher after T-CPR (9.5%; n = 13) than without T-CPR (4.5%; n = 15; p < 0.05; OR 0.471; 95%CI 0.218–1.015). All T-CPR patients showed excellent or good neurological function (CPC 1 + 2) whereas one quarter of patients without T-CPR had adverse neurological outcome (n = 4 CPC 4; n = 1 CPC 3). Overall survival rose from 4.4% (2010) to 7.6% (2011; p < 0.01).

Conclusions: Our study is the first to show that T-CPR is effective in scarcely populated areas. Analysis of 2012 to 2015 data is currently performed.

References

http://dx.doi.org/10.1016/j.resuscitation.2016.07.164


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Background: The international resuscitation committees have put forward multiple strategies to optimize health-care delivery and expenditure following cardiac arrest. We sought to identify national trends in survival and healthcare cost post out-of-hospital cardiac arrest (OHCA).

Methods: We used the 1995 to 2013 Nationwide Inpatient Sample database to identify adults ≥18 years, with an ICD-9 code principal diagnosis of ventricular fibrillation (427.41) or cardiac arrest (427.5). Age and gender adjusted survival rates were studied in the overall sample and by initial rhythm. Temporal trends in survival, hospital charges and cost were examined with year as a continuous variable (1995–2013) added to the multivariable regression model. All charges and costs were adjusted using the consumer price index with 2015 as the index year.

Results: From 1995 to 2013, of 247,684 OHCA patients who survived to hospital admission, 126,690 (51.1%) had ventricular fibrillation, and 123,098 (49.3%) survived to hospital discharge. Mean age was 66.7 ± 14 years. There was no significant increase in the proportion of survivors to hospital discharge from 49.9% (95% CI 39.8–60.0%) in 1995 to 54.0% (95% CI 46.3–61.8%) in 2013 (P trend = 0.56). However, there was a significant increase in VF survival from 73.1% (95% CI 60.8–85.5%) in 1995 to 79.0% (95% CI 70.9–87.2%) in 2013 (P trend < 0.001). In addition, a significant decrease in survival to discharge was noted in non-VF rhythm from 28.2% (95% CI 15.4–41.0%) in 1995 to 19.9% (95% CI 10.0–29.8%) in 2013 (P trend < 0.001). The median inflation-adjusted total hospital charges and costs for the overall cohort were $29,038 [$13,254, $77,499] and $10,079 [$4,893, $25,320] respectively. Both cost and charges increased significantly over years (All P trend < 0.001).

Conclusions: We found a significant increase in expenditure and economic burden in caring for OHCA patients with minimal change in overall survival. Guidelines dissemination and clinical provider education on quality, low-cost, high-value care are essential for better control of national health-care costs and expenditure.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.165

http://dx.doi.org/10.1016/j.resuscitation.2016.07.166

AP119

Can oxygen delivery (DO2) and consumption (VO2) be prognostic factors after an out-of-hospital cardiac arrest?

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2 Wroclaw Medical University, Wroclaw, Poland

Purpose of this study: Effective resuscitation improves prognosis, optimizing myocardial function (cardiac index) and systemic perfusion. Sudden out-of-hospital cardiac arrest (OHCA) due to a heart disease is the most common cause for starting cardiopulmonary resuscitation. A sudden drop in oxygen delivery (DO2) and/or consumption (VO2) resulting from a sudden cardiac arrest (SCA) abnormally decreases mixed venous oxygen saturation and elevates plasma lactate levels. The aim of the study was to assess the DO2 and VO2 indices in patients after OHCA due to myocardial infarction.

Materials and methods: The study included 50 unconscious patients admitted to a cardiac intensive care unit after OHCA caused by an acute coronary syndrome. The group included 16 (32%) women and 34 (68%) men, aged 25–92 years (mean, 64.3 years). The overall mortality equalled 74%.

Results: In the subgroup of patients who died during treatment, the average DO2 values were lower than among those who survived, and lower than the reference (520–600 mL/min/m²). Statistically significant differences were found between the subgroups on days 1–6 of hospitalization. Among the patients who survived, the average DO2 values were around the lower limit of normal. The average VO2 in patients who died was lower than in the subgroup who survived. The average VO2 values in this subgroup were around the lower reference limit (110–160 mL/min/m²). Statistically significant differences between the subgroups were found on treatment days 1 and 2. There was a significant positive correlation between DO2 and VO2 on treatment days 1 and 3 (rho 0.68 and 0.74, respectively; p < 0.00). The chi-square test was used for comparisons between groups. Statistical significance level was set at p < 0.05 and two-tailed p-values were reported.

Conclusions: Most patients were transported to appropriate level of care following evaluation by NEWS. NEWS could not predict transport to a secondary hospital.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.167
AP121

Out-of-hospital cardiac arrest in the Reykjavik metropolitan area 2008–2015, an ongoing story

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2 University of Iceland, Reykjavik, Iceland

Purpose of the study: Survival after out-of-hospital cardiac arrest in Reykjavik has been studied since 1976. Resuscitations were performed by a physician and paramedics until 2008 when paramedics took over the service. The purpose of our study was threefold: to evaluate survival after out-of-hospital cardiac arrest of presumed cardiac origin in the Reykjavik metropolitan area from 2008 to 2014, to compare that to previous studies and to determine factors influencing survival.

Materials and methods: Data from the Capital District Fire and Rescue Service registry of resuscitations and deaths were collected according to the Utstein 2004 standard. Additional data were collected from patients' charts at Landspitali University Hospital, from autopsy charts and from the National Death Registry. The study was approved by the Health Research Ethics Committee at Landspitali.

Results: Of the 636 calls received for cardiac arrest in the study period, resuscitation was attempted by ambulance crew in 457 (71%). Cardiac arrest of presumed cardiac origin counted for 270 (59%) of all resuscitations, or 25/100,000/year. The average age was 69.9 years and the majority were men (78%). Average time to arrival of an ambulance was 7.2 min. Survival to hospital admission was 39% and, in 22% of all cases, the patient survived to discharge. Minor brain injury, Cerebral Performance Category 2, was suffered by 13%. Cardiac arrest was witnessed in 166 cases and witnesses used basic life support in 102. If there were witnesses, basic life support was attempted and the first recorded rhythm was ventricular fibrillation or tachycardia; survival to discharge was 41%.

Conclusions: The rate of out-of-hospital cardiac arrest due to cardiac causes is decreasing in the Reykjavik Metropolitan Area. The survival and neurological outcome is good, compared to other countries. Basic life support is widely used. Replacing physicians in the ambulance system with well-trained paramedics does not significantly affect the survival of patients in cardiac arrest.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.169

AP122

Traumatic cardiac arrest: A no through road. Data from Pavia CARE

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2 Division of Cardiology, Fondazione IRCCS Policlinico San Matteo, Pavia, Italy
3 SOREU della Pianura, AREU, Milano, Italy
4 University of Pavia, Pavia, Italy
5 AAT 118 Pavia, Fondazione IRCCS Policlinico San Matteo, Pavia, Italy

Purpose: Survival after a traumatic out-of-hospital cardiac arrest (OHCA) is not well known. Many evidences suggest that it is very low, whilst other studies highlighted that it is similar to OHCA of medical aetiology. The aim of our study was to assess survival at 1 month of people who suffered a traumatic OHCA in the Province of Pavia.

Methods: We considered all OHCA that occurred in the Province of Pavia between October 2014 and December 2015 using data of our cardiac arrest registry (Pavia CARE) and we performed a sub-analysis of the patients who suffered a traumatic OHCA.

Results: In 14 months, there were 951 confirmed OHCA in our province and 74 of them (7.8%) were of traumatic origin. Only in 22 cases (29.7%) a resuscitation was attempted; whilst 52 patients (71.3%) were obviously dead before or at the arrival of EMS, 80% of cases were witnessed and, in 35%, the first resuscitation was performed by bystander, with a ratio of bystander CPR similar to OHCA of medical aetiology. The first rhythm was a non-shockable one in all the patients and only 1 patient survived at admission to hospital, whilst none survived at 1 month after the event.

Conclusions: Our results suggest that the outcome after a traumatic OHCA is very poor. According to our evidence, this type of OHCA is a sort of no through road since all the patients were dead 30 days after the event.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.170

AP123

Students’ attitudes towards BLS/AED training: Results from a survey of Sudan Resuscitation Council Courses participants

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2 Zagreb University School of Medicine, Zagreb, Croatia
3 Department of Medical Informatics, Rijeka University School of Medicine, Rijeka, Croatia

Purpose of the study: Modern medical educational programs include didactic lectures, mentored clinical teaching, together with directed self-study. Safe medical practice builds on repetitions and routines. Introducing BLS/AED training, by imparting cognitive knowledge and psychomotor skills, in university settings, has been widely recommended long-term strategy to educate the wider scope of healthcare professionals towards ensuring standardized patient care. In our study, we aimed to assess final-year medical and dental student attitudes towards BLS/AED training.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.169
Materials and methods: A total of 137 (60%) of 227 medical and 60 (77%) of 78 dental students, participants of BLS/AED courses in Khartoum, Sudan, completed an online survey. Median age of medical (73% female) and dental (95% female) students was 24 years (range 21–30). The survey consisted of demographic data, and 15 statements regarding BLS/AED training. The responses were Likert-type, ranging from 1 (strongly disagree) to 5 (strongly agree), where theoretical range of results was the score of minimum 15 (negative attitude), and maximum 75 points (positive attitude).

Results: Cronbach's alpha of the whole scale was 0.75, indicating acceptable internal consistency. There was no difference in attitudes towards BLS/AED training between medical and dental students ($P=0.066$), as well as between genders (median female 64 vs. male 63; $P=0.305$). The average score on the BLS/AED scale was 64 (5th percentile 55–95th percentile 72), indicating overall positive students' attitudes towards BLS/AED training. Both, medical and dental students expressed the strongest agreement with the statement that BLS/AED training should commence already in medical school (78% vs. 70%), whereas the least agreement was with the statement that learning BLS/AED during undergraduate years is financially supported/encouraged by parents (17% vs 14%).

Conclusions: Our study demonstrated that medical and dental students have very positive attitudes towards BLS/AED, strongly supporting compulsory BLS/AED training throughout undergraduate studies.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.171

AP125

The clinical implication of hypoglycaemia in patients with out-of-hospital cardiac arrest

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Background: Though hypoglycaemia was considered as one of reversible causes for out-of-hospital cardiac arrest (OHCA), the association of hypoglycaemia and outcomes of patients with OHCA was never validated.

Methods: A cohort, observational study was conducted in the emergency department (ED) of a tertiary university hospital between 1 January 2008 and 31 December 2009. Subjects consisted of consecutive patients with non-traumatic OHCA. Based on the blood glucose level obtained on the patient’s ED arrival, enrollees were categorized into two groups: hypoglycaemic group (defined as blood sugar <60 mg/dl) and the non-hypoglycaemic group. Patient characteristics, laboratory findings, and outcomes were compared. Two-tailed $p$-values less than .005 were considered significant.

Results: A total of 329 enrollees (age range 10.0–96.0 years, mean 69.3 ± 17.4 years; male 57.1%) were divided into the hypoglycaemic group ($n=45$, 13.7%; glucose level range 19.0–60.0 mg/dl, mean 28.8 ± 14.6 mg/dl; age range 36.0–88.0 years, mean 73.5 ± 13.0 years; male 55.6%) and the non-hypoglycaemic group ($n=284$, 86.3%; glucose level range 61.0–1005.0 mg/dl, mean 205.7 ± 131.9 mg/dl; age range 10.0–96.0 years, 68.6 ± 17.9 years; male 57.4%). The hypoglycaemic group and the non-hypoglycaemic group had no significant differences in ever return of spontaneous circulation (13.3% vs. 18.3%, $p=0.66$), sustained spontaneous circulation more than 2 h (11.1% vs. 12.0%, $p=0.87$), sustained spontaneous circulation more than 48 h (2.2% vs. 7.7%, $p=0.18$), sustained spontaneous circulation more than 24 h (2.2% vs. 7.7%, $p=0.62$), or survival to discharge (0.0% vs. 1.8%, $p=0.37$).

Discussions and conclusions: The clinical outcomes of OHCA in hypoglycaemic patients did not have significant differences with non-hypoglycaemic patients. The clinical implication of hypoglycaemia in patients with OHCA needs further investigation.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.173

AP126


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Introduction: Cardiovascular diseases are currently the leading cause of death in industrialized countries and have been the cause of death in approximately 50% cases in Latvia during recent years. The State Emergency Medical Service (SEMS) has an essential role in acute coronary syndrome (ACS) patient care.

Materials and methods: A total of 329 enrollees (age range 10.0–96.0 years, mean 69.3 ± 17.4 years; male 57.1%) were divided into the hypoglycaemic group ($n=45$, 13.7%; glucose level range 19.0–60.0 mg/dl, mean 28.8 ± 14.6 mg/dl; age range 36.0–88.0 years, mean 73.5 ± 13.0 years; male 55.6%) and the non-hypoglycaemic group ($n=284$, 86.3%; glucose level range 61.0–1005.0 mg/dl, mean 205.7 ± 131.9 mg/dl; age range 10.0–96.0 years, 68.6 ± 17.9 years; male 57.4%). The hypoglycaemic group and the non-hypoglycaemic group had no significant differences in ever return of spontaneous circulation (13.3% vs. 18.3%, $p=0.66$), sustained spontaneous circulation more than 2 h (11.1% vs. 12.0%, $p=0.87$), sustained spontaneous circulation more than 48 h (2.2% vs. 7.7%, $p=0.18$), sustained spontaneous circulation more than 24 h (2.2% vs. 7.7%, $p=0.62$), or survival to discharge (0.0% vs. 1.8%, $p=0.37$).

Discussions and conclusions: The clinical outcomes of OHCA in hypoglycaemic patients did not have significant differences with non-hypoglycaemic patients. The clinical implication of hypoglycaemia in patients with OHCA needs further investigation.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.173
Aim: To study ACS patients with cardiac arrest (CA) resuscitation results at prehospital stage and factors influencing resuscitation success in 2010–2015 in Latvia.

Materials and methods: Cohort of 1186 reanimated in 2010–2015 ACS patients was studied. Patients age, gender, ACS characteristics (STE/NSTE, STE localization, cardiac arrest rhythm), time of visit (day/night), time to patient, team staff (physician/physician assistant) were in comparison between studied years and groups of resuscitated and no resuscitated patients. SEMS archive data were analyzed retrospectively by using appropriateto-data statistical methods.

Results: The SEMS of Latvia carried out 6595 emergency medical visits to ACS patients in 2010 (CA-127, successful resuscitation (SR)-52), 10490 in 2011 (CA-224, SR-102), 11978 in 2012 (CA-234, SR-123), 12561 in 2013 (CA-248, SR-137), 8939 in 2014 (CA-163, SR-84), and 9467 in 2015 (CA-191, SR-111). Incidence of CA was found higher in male patients (63.3%, p < .001). Resuscitated patients were younger (64.8 (13.1) years vs 70.4 (12.4), p < .001), more successfully were resuscitated patients younger than 65 years (47.7% vs 29.2%, p < .001, OR 2.14 (1.27; 3.62)) in 2014–2015. No significant differences in resuscitation results were found in dependence on team staff, time of visit, or time to patient.

Conclusion: SEMS of Latvia resuscitation success in cases of ACS complicated with CA depended mainly on patient’s individual characteristics and characteristics of ACS.

Methods: A didactic program to enhance DATCPR included guideline-based protocol changes, staff training, ergonomic CAD interface, computerized audit, feedback, and leadership rebuilt has been launched and consistently run. A comprehensive quality control (QC) program that regularly included OHCA recognition and DATCPR performance as Key Performance Indicators (KPI) for the CAD system has been implemented 1 year later. The proportions of BCPR and survival after QC implementation (Q1), by collecting a 6-month database from a community-wide OHCA e-Registry, are compared with that of the same month period in the prior year as control group (Q0), using regression analysis for statistics.

Results: There were 3777 OHCA [1929 P0, 1848 P1; 63% male, median age 76 (IQR: 58–86)]. The rate of BCPR went from 30.7% in Q0 to 35.3% in Q1 (p < .001). Outcome of sustained ROSC (return to spontaneous circulation) was significantly higher in Q1 compared to Q0 (26.8% vs. 21.7% p < .001), as was survival to hospital discharge (10.6% in Q1 vs. 7.7% in Q0 p = .03). Good neurological outcome (CPC 1 or 2: 6.7% in Q1 vs. 4.7% in Q0 p = .053) was higher but not significant. In subgroup analysis, after adjusting for witnessed arrest, shockable rhythms, age, sex, pre-hospital time intervals, endotracheal intubation, intravenous epinephrine, extracorporeal CPR, and targeted temperature management, good neurological outcome was significantly higher in Q1 vs. Q0 (adjusted odds ratios: 2.1 [95%CI 1.1–4.1], p = .03) for patient age >55.

Conclusions: A comprehensive QC program of DATCPR guidelines in a metropolitan EMS system was associated with significant improvement in the rate of BCPR and, for patients of age >55, a better good neurologic outcome after OHCA.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.175
AP128
Ethical aspects of enrolling cardiac arrest victims into a research project

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Introduction: Enrollment of patients who are being actively resuscitated to a clinical study is an ethically challenging issue. However, lack of similar studies warrants such an approach to prove the effectiveness of novel therapies and approaches.

Our study is an ethical substudy of an ongoing randomized study on refractory out-of-hospital cardiac arrest. The aim of our current study is to provide a deeper patients’ perception of the fact of being enrolled into a cardiac arrest study and randomized into one of the treatment arms without providing an informed consent. Similarly, their relatives are being audited for their perception of the fact that their close person might have been enrolled into a cardiac arrest clinical study and even randomized.

Methods: A written survey has been offered to cardiac arrest survivors, to their relatives and also to relatives of cardiac arrest victims, who did not survive their cardiac arrest. As a comparison group, a similar survey has been offered to populations of myocardial infarction survivors and patients with chronic heart failure.

Results: Currently, we have collected answers from 28 cardiac arrest survivors and 31 patients with chronic heart failure. All patients agreed on a need to perform research projects on cardiac arrest victims while being unconscious and unable to provide informed consent. Twenty-six out of 28 cardiac arrest survivors agreed with the fact of being enrolled into such a project. Moreover, 25 agreed on the fact of being randomized to one of the treatment arms.

Conclusions: Cardiac arrest survivors do not perceive negatively the fact of being enrolled into a clinical study while unable to provide informed consent. The majority even agree with the possibility of being randomized into one of the treatment arms.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.176
AP129
Development of a national approach to resuscitation decisions: The Recommended Summary Plan for Emergency Care and Treatment (ResPECT)

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Background and purpose: Discussing, making and documenting do-not-attempt-resuscitation (DNACPR) decisions can be challenging. Problems highlighted by qualitative and quantitative research include: misinterpreting DNACPR decisions, resulting in withholding of other treatments; poorer care for those with DNACPR decisions than for similar patients without; inconsistent CPR decision-making; too many futile or unwanted CPR attempts; different ways of recording CPR decisions; and reluctance of patients and doctors to discuss CPR.

We set out to address these problems by developing an evidence-based, consultative, national approach to resuscitation decisions.

Methods: Following a review of national and international practices, an adapted Delphi process was used to iteratively develop an Emergency Care & Treatment Plan (ECTP). A public consultation was undertaken; input from graphic designers with behavioural experience was obtained.

Results: Thirty-seven stakeholders were recruited, representing professionals and patient groups from a range of care settings, age-group interests and specialties. Consensus was reached that an ECTP should: contextualise resuscitation decisions among overall goals of care; facilitate early discussion with patients and their families; and be recorded on a single piece of paper (or digital equivalent), for access in an emergency.

It was acknowledged that the ECTP would require education of healthcare professionals and the public, and could help drive a culture change in anticipatory decision-making.

At least 25 iterations of the ECTP were worked through before the public consultation, which attracted 1113 responses; 91% respondents thought the ECTP a good idea. Specific suggestions led to a further 22 iterations and the Recommended Summary Plan for Emergency Care and Treatment (ResPECT).

Conclusions: The ResPECT process has been developed in consultation with experts and the public. It summarises recommendations for care and treatment in the event of a medical emergency, including cardiac arrest, based on what a patient would and would not want and what is clinically possible.

References

http://dx.doi.org/10.1016/j.resuscitation.2016.07.177

AP130
Mapping coherence with new guideline in First Aid curriculum

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Background and purpose: In 2015, the European Resuscitation Council (ERC) released the first European guidelines on first aid for laypeople. Barriers to implement new guidelines include a lack of provider’s awareness that the guidelines exist and whether existing practice cohere with the new guidelines.

The purpose of this study was to demonstrate the use of a systematic evaluation of a national first aid curriculum and to illustrate how to identify coherence with the new ERC first aid guidelines on a national level.

Method and materials: In Denmark there are 10 books containing instructions and guidance for first aid for laypeople. A checklist consisting of 16 different subjects with a total of 31 elements based on the new guidelines on first aid was developed and adapted to follow the MECE principle of mutually exclusive and collectively exhaustive questioning. Further, a standardized manual for answering the checklist was developed. Four different raters where used to assess the reliability of agreement between raters, Fleiss’ Kappa test was used to exclude elements with inconsistent answers.

Results: A total of 10 books published between 2009 and 2015 were evaluated using the checklist. On average, the books were in adherence to new guidelines in 36% of the elements on the checklist. Subjects that included elements which had less than 50% coherence with guidelines were: positioning of shock victim, bronchodilator administration, aspirin administration for chest pain, adrenaline for anaphylaxis, exertion-related dehydration, control of bleeding, use of a tourniquet, open chest wound, cooling burns, burn dressings and dental avulsion.

Conclusion: This study illustrates how to systematically identify coherence with the new ERC first aid guidelines on a national level and identified subjects that did not cohere with the guidelines. This can be used to improve the first aid curriculum.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.178

AP131
New National EMS dispatch performance standard in the Czech Republic

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Background: In the Czech Republic, there are 14 emergency medical dispatch (EMD) centres. A new national intention to measure their key performance capabilities was adopted by the Czech Society of Emergency Medicine in December 2015. In this stage, four parameters are defined and data are collected since January 2016. In the future, specific quality targets are expected to be set for individual parameters.

Material and methods: This abstract is intended to present the standard itself as well as first results from emergency medical
service (EMS) for the City of Prague for the period from January to March 2016. Key parameters are:

- access to emergency line (percentage of calls answered up to 120 s);
- EMD response interval \(^1\) for first-priority calls (percentage of cases forwarded to first resource up to 120 s);
- sensitivity of confirmed out-of-hospital cardiac arrest recognition by EMS call-taker (dispatcher-assisted resuscitation started);
- on-call direct activation of emergency helicopter (HEMS) in cases of serious trauma (percentage of all serious trauma cases transported to high-level trauma center by helicopter).

Results: In EMS dispatch center city of Prague (1.5 million inhabitants, 220,000 calls to EMS, 120,000 open cases in 2015), the following results were reached in the first 3 months of 2016. Access to EMS line 95%/10 s; EMD response interval 65%/120 s; sensitivity of OHCA recognition 85%; and on-call direct activation of HEMS: 84%.

Literature:


http://dx.doi.org/10.1016/j.resuscitation.2016.07.179

AP132

Facilitating bystander CPR – A social anthropological study of behavioral change on the Danish island of Bornholm

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Bystander CPR (bCPR) increases survival after OHCA. However, knowledge about what makes laypeople perform bCPR is missing. The aim of this study is to create new insights into the social mechanisms that increase readiness to perform bCPR.

From 2008 to 2010, an intervention was performed on Bornholm (Bornholm to the Rescue) with focus on education in BLS, implementation of AEDs and mass media focus on resuscitation; bCPR increased from 22% to 74% for witnessed OHCA. Three years after the intervention, bCPR was 78%. To analyze this change, a team of social anthropologists conducted fieldwork – observations of everyday situations and qualitative interviews with laypeople and healthcare professionals, journalists and other stakeholders.

An essential finding is that domestication must take place to increase readiness to perform bCPR. Domestication refers to a sociocultural process where new – technical, practical and moral – elements are incorporated into everyday life, thereby laying the foundation for behavioral change. Central elements in this change were:

- A local initiator: anchored the project locally as a basis for support and commitment.
- Local media: disseminated experiences with OHCA making bCPR relevant.
- Courses at workplaces: embedded CPR skills in meaningful contexts.

- MiniAnne\(^6\): an object to practice CPR skills and make the issue present in everyday life.
- Public AEDs: a help in OHCA situations and a permanent reminder of one's obligation to act.

Bornholm to the rescue succeeded in domesticating these elements, thereby enhancing many islanders' readiness to act. A new readiness to perform bCPR was developed through processes of domestication.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.180

AP133

What is our motivation for teaching on European Trauma Course (ETC)? Results from a survey of active ETC instructors in Austria

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Purpose of the study: Essence of teaching is delivering more than simply content. Therefore, ETC education on trauma resuscitation promotes didactic strategies fostering positive interactions between the learners and teachers. Course design focuses on assuring flexibility to meet individual trainee needs, while pursuing a teaching approach that is simplified and standardized approach to trauma patient management. Today, teachers engage with the world to make a positive impact. In our study, we aimed to investigate the instructors’ motivation for teaching on ETC in Austria.

Materials and methods: A total of 47 (73%) of 64 active ETC instructors in Austria completed an online survey. The survey consisted of demographic data, and 11 statements regarding motivation of teaching on ETC. The responses were Likert-type, ranging from 1 (strongly agree) to 5 (strongly disagree).

Results: Median age of instructors (65% male) was 41 (range 29–70). Almost half of instructors were anaesthetists (43%), followed by trauma surgeons, emergency physicians, intensive care specialists and general practitioners in descending order. The majority of them (40%) participate in at least one ETC course annually. Nearly one third of instructors have been actively supporting Austrian ETC group during the past 3 years. Our instructors expressed the strongest agreement with the statement that ETC simulation based learning, when compared to traditional methods, improves management of acute trauma cases (64%) and that ETC guides them in developing non-technical skills as a team-leader and a team-member (53%). They disclosed the least agreement with the statement that they are instructing on ETC in order to preserve active instructor status in European Resuscitation Council’s database (15%).

Conclusions: Our results suggest that our instructors’ greatest motivation for teaching on ETC is personal fulfilment in the
knowledge that their actions can contribute positively to the lives of others.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.181

AP134

Change management and training changes in trauma resuscitation: Watch out for workflow

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Background: Every 5 years, the ERC presents Guidelines changes, based on evidence and coupled to implementation strategies. A new Dutch EMS standard (LPA8) incorporates fundamental changes to cervical spine (collar) management during resuscitation of trauma patients. The strategy changed from “always (cervical collar) immobilization, except...” to “no collar immobilization, except...” with as goal decreased intra-cranial pressure. We observed that presentation of semi-reclining patients in a vacuum mattress, or with just head blocks, seemed related to an overall major increase in content- and procedure-oriented protocol deviations, not seen after CPR guideline changes. Note, for example, that semi-reclining cannot be continued on a CT-gantry.

Materials and methods: We systematically observed the effects on workflow and training. We approached trained team participants, asked their opinion/motivation on the change, deviations and remediation with, as a goal, a new consensus, workflow and content.

Results: Major key medical and training points were:

- Change in cervical spine management was seen as a preemptive, poorly communicated, fundamental deviation from key training and treatment points, based on limited evidence. Intrinsic perception of causing sub-standard care caused low acceptance: acceptance factor.
- Change management caused loss of overall focus in the resuscitative surveys: focus factor.
- Change required un-learning ingrained workflow: workflow skills factor.

We found that non-acceptance (most frequently seen as “yes, but...”) early in workflow is strongly related to a negative domino effect throughout the whole team effort leading to errors, increased run-through time and missed finding during the surveys. Retraining needed to focus on acceptance, un-training and then re-training. Particularly, the historical strategy persisted strongly. Notably, we found that not changing care and workflow, despite paucity of supporting evidence, seems to be better accepted than introducing changes with equally strong or ambivalent evidence. Level of seniority could not be indicated as a consistent factor.

Conclusion: Change management requires acceptance by all chain partners. Changes perceived as fundamental require specific attention (un-learning, motivation in the face of selective evidence, re-commitment). Introduction of even small distractions to workflow may cause disproportionate errors and deviations from care standards.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.182

AP135

Challenges instructors meet while teaching on European Trauma Course (ETC)

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Purpose of the study: The ETC team training approach reflects exemplary management of traumatized patients admitted to shock rooms throughout Europe. All trauma scenarios have predetermined specific learning objectives, addressing medical, communication or leadership issues frequently encountered during trauma resuscitation. In this study, we wanted to identify challenges that instructors meet while teaching an European Trauma Course.

Materials and methods: A total of 47 (73%) of 64 instructors, actively teaching on at least one ETC course in Austria annually, completed an online survey from 5th until 10th of May 2016. The survey consisted of demographic data, and 18 statements regarding challenges instructors meet whilst teaching on ETC. All responses were Likert-type ranging, from 1 (strongly agree) to 5 (strongly disagree).

Results: There were 65% male and 35% female instructors, aged from 29 to 70 years (median 41, interquartile range 12, mean ± SD=42 ± 9). The majority of instructors were specialists in anaesthesiology (43%), along with trauma surgeons, emergency physicians, intensive care specialists and general practitioners working in the prehospital setting. Apart from teaching on ETC, almost half of instructors (47%) are actively teaching on European Resuscitation Councils’ Advanced Life Support Courses. The majority of instructors (91%) are confident with the modified four-stage approach in skills teaching during ETC. Nearly a third of them (28%) have impeding fear of not being proficient enough in debriefing technique, and of failing to meet the scenarios learning objectives (31%). Almost one third of instructors (34%) reported difficulties in attaining educational leave from working institutions in order to participate in the ETC.

Conclusions: Our results suggest instructors actively teaching on the ETC feel confident with the course structure and educational principles. Nevertheless, they still face some difficulties, one of them being less confidence in successfully meeting the learning objectives during ever-growing trauma scenarios that cover a wide spectrum of major trauma resuscitation issues.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.183
Outcome mechanical CPR (LUCAS™2) vs. conventional CPR

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Introduction: The aim of this study is to compare the difference in outcome between manual and mechanical cardiopulmonary resuscitation (CPR). It has been suggested that the overall outcome would not be significantly different between conventional CPR (cCPR) and mechanical CPR (mCPR), including neurological outcome.

Methods: This retrospective study analysed, from 5 September 2013 to 22 August 2015, a total of 96 OHCA patients who underwent an X-ray or other imaging after ROSC.

Results: On a total of 96 patients, 69 (71.88%) received cCPR, while 27 (28.13%) received both conventional as mCPR. Minimally, one complication has been found in 31.88% of the cases in the cCPR group vs. 33.33% treated with mCPR (p = 0.89). Overall, 32.29% of the analysed cases had complications after CPR, 25% were male vs. 45.88% female (p = 0.03); of those cases, 77.41% pertain to the age category above 60 years; 16.67% of the patients had good cerebral performance categories (CPC 1–2) whereas 9.37% went home with major neurological damage (CPC >2) and the remaining 73.96% deceased in the hospital. Too little data were available to make a clear distinction between both groups in terms of neurological outcome, but the results are in line as suggested in the literature.

Conclusion: There is no overall significant difference in terms of outcome between cCPR and mCPR. We found a trend of more complications reported a high level of perceived benefit. After taking part in the NLS course, participant skills increased significantly. This improvement of practical skills was also reflected in the perception of the participants. These findings demonstrate the immediate effectiveness of the simulation-based NLS training across occupational groups.

Evaluation of the effect of the Newborn Life Support (NLS) course in Germany on resuscitation skills and the participants’ perceived benefit

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Purpose of the study: To date there has been no evaluation of the effect of resuscitation skills of the NLS-course carried out in Germany. The purpose of the study was to compare the performance during simulation of resuscitation of a term newborn before and after participating in the NLS-course, and to complement it with the participants’ perceived benefit from the course.

Materials and methods: A 42-item resuscitation performance scoring methodology was developed. It included all detailed steps of resuscitation of a term newborn referring to the NLS-Guidelines; 74 randomly selected participants were tested between 2010 and 2012, both before (t1) and directly after taking part (t2) in the course. Participants were tested by trained NLS instructors by observing a simulated resuscitation and applying the scoring methodology. Single steps which could not be verified by observing were judged by verbally examining the participants using predefined questions. The practical test was complemented by an anonymous questionnaire where participants rated organizational aspects of the course and their perceived benefit.

Results: 61 participants of different occupations were included removing non-analysable forms (missing data ≥8 items for t1 and t2; missing data ≥6 items for t1 or t2). The average points improved from pre-training 25.9 (61.6%) to 39.1 (93.0%) post-training (p ≤ 0.001) referring to the possible attainable number of 42 (100%) points. An improvement (p < 0.05) of the arithmetic mean of all groups was shown. Participants of all occupational classifications reported a high level of perceived benefit.

Conclusions: After taking part in the NLS course, participant skills increased significantly. This improvement of practical skills was also reflected in the perception of the participants. These findings demonstrate the immediate effectiveness of the simulation-based NLS training across occupational groups.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.184

Purpose of the study: To develop and launch a standardised national course in the UK that built on the existing Newborn Life Support (NLS) course and teaches the technical, communication and human factor skills required to provide advanced neonatal resuscitation in the labour ward and neonatal intensive care unit.

Methods: A 2-day course was developed comprising lectures, small-group workshops, skill stations and simulations. Innovative airway training was used, a new continuous assessment process devised and a course manual published. The course has a multi-disciplinary target audience including doctors working in a middle grade role or above and specialist neonatal nurses with >2 years of experience.

Results: Proof of concept and 2 pilot courses were successful. There are now 8 course centres operational that have delivered 13 courses, training 208 ARNI providers and 30 instructors. Summative feedback has been given to candidates on safety during intubation, quantitative feedback about facemask leak and formative continuous assessment on technical and communication skills. Unsuccessful candidates have predominantly failed for communication or human factors rather than technical reasons. The course programme, training materials and feedback to and from candidates will be discussed.

Conclusions: A new, innovative, national neonatal resuscitation course has been successfully launched in the UK by the Resuscitation Council (UK). It provides a new model of assessment that could be adopted by other courses and provides in-depth feedback to candidates on technical and non-technical factors.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.186
Implementation of blended learning and mastery learning principles to increase paediatric resuscitation skills of final semester medical students

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Purpose: Mastery of paediatric resuscitation is challenged as medical students only face a few seriously ill children during training in paediatric departments. Blended Learning (BL) may increase student’s knowledge and Mastery Learning (ML) may increase the skill level. We investigated the current paediatric resuscitation knowledge and skill level and the effect of combining BL and ML for paediatric resuscitation by medical students.

Material and methods: A control group (CG) received the existing clinical education programme in paediatrics (February–June 2016). The intervention group (IG) will (September–December 2016) additionally participate in an online interactive course presenting the paediatric resuscitation principles using videos and multiple-choice questionnaires (MCQ). Further, a simulation-based ML course will include recognition and resuscitation of the critically ill child. Both groups receive a questionnaire. Randomly selected students from both groups will be tested for resuscitation skills by answering MCQs and a performance test using a simulated paediatric resuscitation setting and will be assessed using both a dichotomous scale and a global rating scale (GRS).

Preliminary results: Preliminary data from the CG is available (n = 102, of 179). The questionnaire identified that 91% requested more resuscitation training. In the CG (n = 28); 7% (n = 2) passed the MCQ, median score 50% (range 25–75%). Only 4% (n = 1) passed the performance test. Using a dichotomous scale, the median of correct actions was 40% (range 15–70%) and, on GRS, the median was 12/30 points (range 8–22). Evaluation of the airway was done correctly by 4% of the students; 40% performed chin-lift/jaw-thrust, 32% performed bag-mask-ventilation when indicated and 18% called for help.

Conclusion: Final-semester medical students require more training in paediatric resuscitation. Despite having concluded paediatric resuscitation training, students lack both theoretical knowledge and performance level. The effect of the combined BL and ML course will be presented.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.187

Factors to improve paediatric cardiopulmonary resuscitation outcomes in nationwide emergency centres

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Purpose: Cardiac arrest in children occurs less frequently than in adults. Epidemiological investigations and factor analyses have been undertaken internationally to prepare strategies for improved survival outcomes of cardiac arrest; however, they pertain mostly to adults. Recently it was reported that the prognosis of paediatric cardiac arrest was not as improved as in adults in South Korea. We investigated the patient and hospital characteristics that affect the survival outcome in children, in order to establish a strategy to improve the survival rate of paediatric cardiac arrest.

Materials and methods: Of the 148 emergency centres in Korea; this study was conducted in 128 hospitals where cardiopulmonary resuscitation (CPR) was performed on paediatric patients from 2008 to 2012. Data were obtained from the National Emergency Department Information System. From a total of 2970 resuscitated victims, we evaluated the 1533 atraumatic paediatric cardiac arrest in 122 nationwide emergency departments (EDs). Primary outcome was determined by survival and neurological status at hospital discharge.

Results: The overall rates for survival and favourable neurologic outcomes were 15.8% and 13.0%, respectively (Fig. 1). After adjusting for potential confounders, the patient factor to improved outcome was initial shockable electrocardiogram (odds ratio [OR] 55.8, 95% confidence interval [CI] 19.2–161.9), and the exacerbating factor was the visit to the ED at night (OR 0.655, 95% CI 0.508–0.846). Of hospital factors, a greater survival outcome was observed in ED with a higher resuscitation volume (OR 1.384, 95% CI 1.056–1.867) and setting up a CPR training facility (OR 1.834, 95% CI 1.711–1.966).

Conclusions: Admission time, annual CPR volume and CPR training resources were associated with paediatric survival outcomes after resuscitation in ED. These indicate that introduction of the resuscitation centre concept for paediatric patients, similar to adults, would result in improvement of the survival rate.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.188
Interscapular pats or gentle stimulation in the first 4-month-old suspected foreign body airway obstruction

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**Study aim:** Guidelines for suspected foreign body obstruction recommend interscapular pats and chest compressions even during the first 4 months of life. Indeed, the normal reflexes characteristic of this lifetime can be confused with airway obstruction.

The laryngeal (gag) reflex is likely the primary cause which generates a laryngeal obstructive, sometimes protracted, apnoea. Resolution, however, occurs spontaneously. Moreover, the so-called “extrusion reflex” that prevents entry of solids and the inability to bring any object to the mouth at this age offer some “protection” against the risk of foreign body airway obstruction.

Lack of knowledge of this physiological condition can harm babies by providing wrong interventions. A case of cerebral hemorrhage after interscapular patting was documented in our own experience. However, we did not find any case of airway obstruction due to foreign bodies during this period of life.

Our aim was to ascertain whether parents who attend our courses on lifesaving manoeuvres for infant sudden airway obstruction would administer the dorsal pat even in babies younger than 4 months.

**Methods:** A questionnaire was administered to 200 parents who attended our courses on lifesaving manoeuvres:

- If your four-month-old child has a sudden apnoea and becomes blue during breastfeeding, how would you intervene?

1. By applying the interscapular pats and chest compressions.
2. By gently stimulating your baby for 10–15 s.

**Results:**

<table>
<thead>
<tr>
<th>No. of parents</th>
<th>Interscapular pats</th>
<th>Gentle stimulation</th>
<th>No answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>200</td>
<td>94</td>
<td>80</td>
<td>26</td>
</tr>
</tbody>
</table>

**Conclusions:** The need of lifesaving manoeuvres is very rare during the first 4 months of life. The gag reflex is almost unknown among lay people, and this may lead to wrong and potentially harmful manoeuvres. We suggest that the pat manoeuvre should be administered only when a foreign body airway obstruction is certain or at least highly suspected.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.189

Conventional versus compression-only cardiopulmonary resuscitation for pediatric out-of-hospital cardiac arrest in the C(compression)-A(airway)-B(breathing) era: A nationwide, population-based, propensity score-matched study

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**Purpose:** Conventional cardiopulmonary resuscitation (CPR), composed of chest compression and rescue breathing, has been recommended for pediatric out-of-hospital cardiac arrest (OHCA) based on the studies in the A(airway)-B(breathing)-C(circulation) era when compression-only CPR was not widespread commonly. We, therefore, aimed to determine whether rescue breathing for pediatric OHCA is associated with increased chance of favorable outcomes in the C(compression)-A(airway)-B(breathing) era.

**Methods:** A nationwide, population-based, propensity score-matched study was conducted in Japan, from 1 January 2011 to 31 December 2012, based on data from the All-Japan Utstein Registry. We included only pediatric patients with OHCA receiving bystander CPR. A total of 1150 patients were included in the final cohort: 417 received rescue breathing (conventional CPR group) and 733 did not (compression-only CPR group). The primary outcome was favorable neurological outcome 1 month after OHCA. The secondary outcomes included 1-month survival and prehospital return of spontaneous circulation (ROSC).

**Results:** Among 1150 patients, 176 (15.5%) survived with favorable neurological status 1 month after OHCA. Although conventional CPR apparently led to greater chance of favorable neurological outcome than compression-only CPR in the unmatched cohort (25.3% vs. 9.3%, P < 0.0001), there were no significant differences between the two groups after adjusting for potential confounding factors: propensity adjustment, OR 1.20 (95% CI 0.81–1.77); multivariable logistic regression without propensity adjustment, OR 1.47 (95% CI 0.89–2.41); and multivariable logistic regression with propensity adjustment, OR 1.46 (95% CI 0.83–2.62).

On subgroup analyses, the 95%CI for the OR overlapped unity in all subgroups (including the non-cardiac [mainly asphyxial] etiology group).

**Conclusions and relevance:** In this propensity score-matched study of pediatric OHCA in the C-A-B era, conventional CPR was not associated with increased chance of 1-month survival or neurologically favorable survival, compared with compression-only CPR. These contradictory findings to previous studies warrant further randomized clinical trials to determine which method is superior in the C-A-B era.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.190
**AP143**

Echocardiographic patterns of post-cardiac arrest myocardial dysfunction

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**Purpose:** Post-cardiac arrest, myocardial dysfunction can develop after successful resuscitation from cardiac arrest. However, echocardiographic patterns of post-cardiac arrest myocardial dysfunction are not yet known. The purpose of this study was to investigate manifestations of post-cardiac arrest myocardial dysfunction with serial echocardiography during the post-cardiac arrest period.

**Materials and methods:** We enrolled non-traumatic out-of-hospital cardiac arrest patients older than 18 years who were successfully resuscitated after CPR. Patients with myocardial infarction and pre-existing cardiac disease including heart failure or myocardial disease were excluded. Transthoracic echocardiography was performed within 24 h, between 24 and 48 h, after 48 h since restoration of spontaneous circulation (ROSC) was achieved.

**Results:** Of the 263 patients, 186 patients (122 males) were enrolled in the analysis. No left ventricular (LV) dysfunction was observed in 120 patients (64.5%). Abnormal LV dysfunction was observed in 66 patients (35.5%). Abnormal LV dysfunctions included global hypokinesis in 32 patients (17.2%), regional wall motion abnormalities (RWMA) in 25 patients (13.4%) and abnormalities like stress-induced cardiomyopathy in 9 patients (4.8%). There were no differences in etiology (p = 0.275), duration of cardiac arrest (p = 0.078), cumulative dose of epinephrine (p = 0.336) and hospital mortality (p = 0.140) according to the pattern of post-cardiac arrest myocardial dysfunction. In subgroup analysis of the patients with shockable rhythm, cumulative defibrillation energy (joules) was lower in patients without LV dysfunction (101 ± 41) than in patients with RWMA (200 ± 74) or global hypokinesis (408 ± 131) (p = 0.011). Cut-off value of 220J had 21% of sensitivity and 91% of specificity for development of LV dysfunction (AUC = 0.572).

**Conclusion:** Post-cardiac arrest myocardial dysfunction occurs in one third of patients resuscitated from cardiac arrest. Echocardiographic patterns of post-cardiac arrest LV dysfunction include global hypokinesis, regional wall motion abnormalities, and abnormalities like stress-induced cardiomyopathy.

**Reference:**

http://dx.doi.org/10.1016/j.resuscitation.2016.07.191

**AP144**

Temporal trends in the use of cardiac catheterization and percutaneous coronary intervention following out-of-hospital ventricular fibrillation cardiac arrest in the United States

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**Background:** The use of percutaneous coronary intervention (PCI) is associated with survival following out-of-hospital cardiac arrest. We sought to identify temporal trends in the use of cardiac catheterization and PCI following ventricular fibrillation cardiac arrest (VF-arrest).

**Methods:** We used the 2002–2013 Nationwide Inpatient Sample database to identify adults ≥ 18 years old, with an ICD-9 code principal diagnosis of ventricular fibrillation (427.41). Yearly age-, gender- and comorbidity-adjusted rates of cardiac catheterizations and PCI were calculated. Trends in the use of cardiac catheterizations and PCI were examined with year as a continuous variable added to the regression model. Multiple logistic regression models to assess the impact of PCI on survival, were adjusted for patient demographics, hospital characteristics and the Charlson Co-morbidity Index.

**Results:** From 2002 to 2013, of 78,540 VF-arrest patients who survived to hospital admission, 57,569 (73.3%) survived to hospital discharge. Cardiac catheterization was performed in 24,347 (31%) and PCI in 4633 (5.9%). Mean age was 64 ± 0.14 years, 33% were female and 76% were white. Cardiac catheterization performance increased from 22.5% in 2002 to 39% in 2013 (P trend <0.0001), and PCI performance increased from 2.3% in 2002 to 7.4% in 2013 (P trend <0.0001). The use of PCI was associated with survival to hospital discharge (AOR 1.76, 95% CI 1.40–2.23).

**Conclusions:** Nationwide, there was a significant increase in the use of cardiac catheterizations and PCI following VF arrest. Such increase is consistent with published resuscitation guidelines and recommendations although further improvement in such rates is desperately needed. Knowledge transfer remains a major concern in improving clinical practice. Efforts focusing on better knowledge transfer between producers (researchers) and potential users (clinicians) are essential for improving outcomes in this patient population.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.192

**AP145**

Parenchymal lung injuries related to standard cardiopulmonary resuscitation

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**Purpose:** Little is known about parenchymal lung injuries after external chest compressions during cardiopulmonary resuscitation (CPR). We analysed chest CT scan to evaluate parenchymal lung injury and its clinical significance in patients who received standard CPR and were resuscitated from cardiac arrest.

**Materials and methods:** We enrolled non-traumatic out-of-hospital cardiac arrest patients older than 18 years who had been admitted to the ED in cardiac arrest and successfully resuscitated after CPR. Chest CT was obtained immediately after return of spontaneous circulation (ROSC). To allocate the area of lung contusion, we divided both hemithoraces into upper, middle, and lower parts longitudinally and each part was subdivided into four regions (anteromedial, anterolateral, posteromedial, and posterolateral) except the lower part of the left lung. Finally, both lungs were divided into 23 regions. To stratify the severity of lung contusion, each region was scored depending on the area of lung contusion (ALC) with 1 = ALC < 1/3 of a region, 2 = 1/3 ≤ ALC < 2/3 of a region and 3 = ALC ≥ 2/3 of a region. Oxygenation index (OI: PaO2/FiO2) was measured at the time of ROSC, 24 h, 48 h, 72 h, and 1 week after cardiac arrest. Acute lung injury (ALI) was defined as OI below 300.

**Results:** Ninety-one patients were enrolled. Lung contusion developed in 37 patients (40.7%) and median lung contusion score
Identification of regions with maximal body surface-to-environment temperature differences in survivors of out-of-hospital cardiac arrest using an infrared camera

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Purpose of the study: The aim of this study was to use an infrared camera to identify body areas with maximal body surface-to-environment temperature differences in survivors of out-of-hospital cardiac arrest. Identification of areas with the greatest difference is important because of possible improvement of efficiency of external cooling methods.

Materials and methods: We performed a prospective study in April 2016 in 3 male and 1 female adult survivors of out-of-hospital cardiac arrest. All patients experienced cardiac arrest indoors at normal room temperatures. Infrared images (FLIR SC620, FLIR Systems, Wilsonville, Oregon, USA) of supine patients with abducted upper extremities were obtained as soon as possible after admission (t0) and 10 min later (t10). No cooling techniques were used prior to obtaining the final images.

Results: At both time points, high surface temperatures (>34 °C) were present in the head–neck and thorax–abdomen areas; intermediate surface temperatures (30–34 °C) were present in the proximal upper and lower extremities and in the femoral region; and the lowest surface temperatures (<30 °C) were present in distal parts of all extremities. Axillary region changed from a high surface temperature area at t0 to intermediate surface temperature area at t10.

Conclusion: The greatest body surface-to-environment temperature differences can be obtained in the head–neck and thorax–abdomen areas. Smaller temperature differences are present on upper and lower extremities, including the axillary and femoral areas. These results suggest that head–neck and thorax–abdomen areas should be the target areas for optimal body cooling by external methods.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.194

Intra-ischemic therapeutic hypothermia protects cardiomyocytes from reperfusion-induced mitochondrial dysfunction

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2 Pediatric Cardiology, Charité-Universitätsmedizin Berlin, Berlin, Germany

Objective: Therapeutic hypothermia (TH) is an accepted neuroprotective intervention for adults after out-of-hospital cardiac arrest; however, its cardioprotective effect is still unclear. Mitochondrial dysfunction due to ischemia/reperfusion (I/R) injury is a major cause of myocardial cell death. Therefore, the aim of our study is to investigate the effects of moderate TH (33.5 °C) on I/R-induced cell death in cardiomyocytes.

Methods: We established an in vitro model using mouse atrial HL-1 cardiomyocytes. Ischemia was simulated by deprivation of oxygen and glucose (OGD) for 6 h in glucose/serum-free medium at 0.2% O2. Intra-ischemic cooling was initiated after 3 h of OGD. Reperfusion was simulated by restoration of nutrients in complete supplemented medium at 21% O2, followed by maintenance at 37 and 33.5 °C for up to 27 h. Mitochondrial and cytosolic protein fractions were isolated for analysis of mitochondrial membrane integrity as assessed by cytochrome c and AIF releases. Furthermore, anti-apoptotic Bcl-2 and pro-autophagy LC3 protein expressions were analyzed.

Results: We observed significant damage in mitochondrial membrane integrity in cardiomyocytes after exposure to OGD/reperfusion, as indicated by significant increases in cytochrome c and AIF releases. Secondary reperfusion-induced mitochondrial dysfunction was attenuated by intra-ischemic moderate TH. Furthermore, TH induced Bcl-2 and LC3 expressions, indicating protection from apoptosis and induction of autophagy, respectively.

Conclusion: Myocardial ischemia induces intrinsic apoptosis by releasing cytochrome c and AIF into the cytosol. Intra-ischemic cooling effectively attenuated both caspase-dependent and -independent apoptosis induction. Additionally, TH protects cardiomyocytes from I/R-induced injury via Bcl-2 upregulation and induction of autophagy. Therefore, early initiation of TH is crucial for cardioprotection after myocardial ischemia.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.195
Heart rate: Dose it predict a good neurologic outcome during therapeutic hypothermia?

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Background: Resuscitated cardiac arrest patients who remain comatose should be treated with therapeutic hypothermia (TH) to reduce mortality and improve functional neurologic outcome. During TH, heart rates tend to decrease physiologically. However, as of now, there is no international consensus on which heart rate range to be targeted during postresuscitation care.

As it is unknown whether heart rate should be of concern during TH, the objective of the present study was to assess if there is any association between the heart rate after return of spontaneous circulation (ROSC) during TH and neurologic outcome in comatose out-of-hospital cardiac arrest (OHCA) patients.

Method: The Korea Hypothermia Network (KORHN) managed a web-based retrospective registry of cases of OHCA treated with TH that aimed to improve post-cardiac arrest care quality and outcomes. Adult (>18 years) comatose patients treated with TH between January 2007 and December 2012 were included. Cases of cardiac arrest from trauma or stroke or that occurred in the hospital were excluded.

We performed repeated-measures ANOVA at 0, 24, 48 and 72 h post ROSC grouped by either good or bad neurologic outcome.

Result: A repeated-measures ANOVA with a Greenhouse–Geisser correction determined that mean heart rates differed statistically significantly between time points (F = 78.18, p < 0.001), and also differed statistically significantly between two groups (F = 9.01, p = 0.003) (Fig. 1).

Conclusion: The survivor group with a good neurologic outcome has lower heart rates rather than the other group and this difference was statistically significant.

Drowning: Protective role of hypothermia

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CHU Mongi Slim, La Marsa, Tunisia

Introduction: In addition to the respiratory system, in case of drowning, there could be brain damage due to hypoxia and circulatory arrest. Hypothermia, which is almost constant in the process of drowning, has a protective effect on the brain by reducing oxygen demand.

Observation: Patient aged 38 presented with cardiopulmonary arrest due to drowning; transportation was provided by the brigade team, with duration estimated at 15 min without any cardiopulmonary resuscitation (CPR). In the emergency department, external cardiac massage at a rate of 100 compressions per minute and ventilation after endotracheal intubation were immediately initiated, a milligram of adrenaline was administered every 3 min and the patient regained cardiac activity after 10 min; there was a second cardiac arrest and, after 10 min of CPR, the patient had recovered electrical and mechanical cardiac activity. On examination, the patient was then found to be hypothermic (34°C). The outcome was favorable; withdrawal of vasoactive drugs, discontinuation of patient sedation, with awakening and extubation after 30 h of resuscitation, without neurological sequelae was noted. The protective role of accidental hypothermia on brain cells was strongly evoked.

Conclusion: Several recent studies have proven the performance of moderate therapeutic hypothermia after cardiac arrest on shockable rhythms, though as yet unproven for drowning, still seems to be beneficial.

Factors associated with ambulance use in acute coronary syndrome in Victoria, Australia

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2 Baker IDI Heart and Diabetes Institute, Melbourne, Victoria, Australia
3 Curtin University, Bentley, Western Australia, Australia

Introduction: Only half of acute coronary syndrome (ACS) patients currently present to hospital by ambulance. Aiming to improve recognition and ambulance use, the Australian Heart Foundation (HF) released their Warning Signs campaign which addressed some of the known barriers to calling an ambulance.

Aim: Our aim was to examine the impact of the campaign on ambulance use in ACS patients and other factors associated with ambulance use.

Method: Interviews were conducted with 199 consecutive ACS patients admitted to a Melbourne (Australia) hospital between July 2013 and April 2014. Patients were: aged 35–75 years, competent to provide consent, English speaking, not in residential care and medically stable. Multivariable logistic regression was used to examine factors associated with ambulance use.

Results: Although 64% (n = 127) of patients reported seeing the campaign, only 54% of patients presented to hospital by ambulance. Ambulance use was not significantly different in those who saw the...
Physiological disturbances at admission to the emergency department are independently associated with the 30-day mortality among hospitalized patients

Timo Kontula1,2, Jari Kalliomäki1, Mikko Kivipuro1, Satu-Liisa Paunioho1, Arvi Yli-Hankala2, Joonas Tirkkonen1, Heini Huhtala2, Sanna Hoppu1

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2 University of Tampere, Tampere, Finland

Purpose of the study: There are few scoring systems in emergency departments (ED) to establish critically ill patients quickly and properly and to predict hospitalization. We aimed to evaluate the performance of the national early warning scoring (NEWS) system on 30-day mortality in adult medical and surgical patients admitted to the ED and hospital wards with and without adjustment for multiple confounding factors.

Materials and methods: All adult patients admitted to the Tampere University Hospital’s ED during June 2015 were included in the study. Extensive medical and demographic data were collected. NEWS was calculated based on physiological observations at admission, and at 24h/72h after admission among those who were hospitalized. The outcomes of interest were: sudden cardiac arrest, ICU admission, length of stay in the hospital and 30-day mortality.

Demographic data are presented as numbers and percentages, continuous variables as means (SD) or medians (Q1, Q3). Binary logistic regression was used for both univariate and multivariable analysis. All tests were two-sided, \( p < 0.05 \) was considered significant and 95% confidence intervals were calculated. SPSS version 23.0 for Windows (IBM corp., Armonk, NY, USA) was used for statistical analysis.

Results: The cohort analyzed herein consisted of 1588 patients admitted to the ward (age (SD): 62 (19) years; male: 55%). The median (Q1, Q3) Charlson Comorbidity Index (CCI) was 1 (0, 2) and median NEWS (Q1, Q3) 2 (0, 4) at admission; 30-day mortality was 6.2% (Table 1).

In multivariate analysis, it was shown that higher NEWS predicts higher 30-day mortality, OR being 1.30 (95% CI 1.22–1.38) and \( p < 0.001 \) (Table 2).

Table 1

<table>
<thead>
<tr>
<th></th>
<th>Survival after 30 days</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Alive</td>
</tr>
<tr>
<td>( n )</td>
<td>1489</td>
</tr>
<tr>
<td>Age, mean (SD)</td>
<td>61 (19)</td>
</tr>
<tr>
<td>CCI, median (Q1, Q3)</td>
<td>1.00 (0, 2)</td>
</tr>
<tr>
<td>NEWS, median (Q1, Q3)</td>
<td>1.00 (0, 3)</td>
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</table>

Table 2

<table>
<thead>
<tr>
<th></th>
<th>Univariate</th>
<th>Multivariable</th>
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<tbody>
<tr>
<td></td>
<td>OR</td>
<td>95% CI</td>
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<tr>
<td>Gender</td>
<td></td>
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</tr>
<tr>
<td>Male</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>1.13</td>
<td>0.75–1.69</td>
</tr>
<tr>
<td>CCI</td>
<td>1.62</td>
<td>1.48–1.76</td>
</tr>
<tr>
<td>NEWS</td>
<td>1.32</td>
<td>1.25–1.40</td>
</tr>
</tbody>
</table>

Conclusions: Higher NEWS represents higher mortality for patients admitted to the ED and wards, even when adjusted for age and CCI.
are presented in Fig. 1. Results of logistic regression analysis are to be presented in the full poster.

**Conclusion:** Prehospital care physicians base decisions in favour of CPR primarily on already ongoing CPR efforts by EMS, while CPR is withheld principally when recognition of life extinct (ROLE) is possible or advanced directives exist. Other relevant influence factors besides these appear to be both arrest-related (whether the arrest was witnessed and bystander CPR was provided, which initial rhythm was recorded and whether the cause of the arrest was deemed a suicide) and patient-related (especially age, known malignancies and pre-existing dependency in everyday life).

http://dx.doi.org/10.1016/j.resuscitation.2016.07.200

**AP153**

**NULL-PLEASE: A new ‘Futility score’ in the management of survivors of out-of-hospital cardiac arrest**

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**Purpose:** An aggressive approach to early invasive and interventional strategy is being increasingly advocated in survivors of out-of-hospital cardiac arrest (OHCA) based on favourable observational data. On the other hand, the presence of multiple adverse resuscitation features in these high-risk patients may indicate a poor prognosis and the potential futility of an invasive strategy.

**Methods:** We developed a futility score (NULL-PLEASE, range 0–14) incorporating unfavourable initial arrest characteristics (2 points each for Non-shockable rhythm, Unwitnessed arrest, Long ‘no-flow’ period (no bystander CPR prior to arrival to EMS) or Long ‘low-flow’ period (>30 min CPR before ROSC) and patient characteristics [1 point each for pH < 7.2, Lactate > 7, End-stage renal failure on dialysis, Age > 85, Still (on-going) CPR or Extra cardiac cause (e.g. trauma)] and attempted to validate this in a retrospective historical cohort study of 56 consecutive patients admitted to our intensive care unit following OHCA.

**Results:** 16 out of 56 patients (28.5%) survived, with no difference in basic demographics between survivors and non-survivors. The proportions with witnessed arrest and bystander CPR and the initial pH and lactate levels were not statistically different between the two groups. However, survivors were more likely to have an initial shockable rhythm, a cardiac cause for OHCA and were less likely to require the use of inotropes. The NULL-PLEASE score was significantly lower in survivors (3.0 [0.25–3.75]) than non-survivors (6.0 [4.0–7.0]). No patient with a NULL-PLEASE score >6 survived. Regression analysis showed the NULL-PLEASE score as the only independent factor predictive of mortality (odds ratio 1.68, 95% confidence interval 1.03–2.72, p-value <0.001).

**Conclusion:** A score incorporating multiple unfavourable resuscitation features (NULL-PLEASE) may be useful in identifying patients unlikely to survive OOHCA and where an invasive and interventional strategy may be futile.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.201

**AP154**

**RBM3: Possible biomarker for therapeutic hypothermia**

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**Purpose:** Therapeutic hypothermia is a standard of care for adults with ROSC after out-of-hospital cardiac arrest, but not for children. Although hypothermia generally down-regulates protein synthesis and metabolism in mammalian cells, the cold shock protein – RNA-binding motif protein 3 (RBM3) – is induced under these conditions and, thus, is a possible biomarker for therapeutic hypothermia. Therefore, we investigated RBM3 expression in children undergoing cardiopulmonary bypass surgery (CPB) involving hypothermic extracorporeal circulation.

**Method:** Patients >10 kg undergoing CPB with the aid of a heart-lung machine were enrolled in the study. Whole blood was collected in Tempus® Blood RNA and BD Vacutainer® EDTA Blood Collection tubes at three time points: (1) Before connection to the heart–lung machine and cooling, (2) After disconnection from the heart–lung machine and before rewarming, (3) 24 h after disconnection from the heart–lung machine. Samples were analyzed for RBM3 gene expression by RT-qPCR and ELISA.

**Results:** We observed a slight increase in RBM3 protein expression, though not significant, at the end of the cooling phase and a return to baseline level after rewarming. Though the patients were exposed to different cooling protocols (32–34 °C and duration), a general increase in RBM3 protein expression in blood was observed at the end of the cooling phase. No significant differences were observed in RBM3 mRNA expression, in comparison to individual baseline levels.

**Conclusion:** Cooling via the heart–lung machine during CPB surgery resulted in a slight increase in RBM3 expression. Though no significant differences were observed, this is the first time to our knowledge that RBM3 measurement in blood has been reported. Our findings support the establishment of RBM3 as a novel biomarker for therapeutic hypothermia. Additionally, a diagnostic assay will aid in improving the efficacy of therapeutic hypothermia, as well as to establish a standard of care for the pediatric population.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.202

**AP155**

**Correlation between serum lactate, lactate clearance and survival after cardiac arrest**

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**Background:** Sudden cardiac arrest (CA) is still a leading cause of death. Survival with good neurological outcome remains poor. Prognostic factors to determine early neurological outcome are rare.

**Objective:** To determine the association between initial lactate values and lactate clearance on survival and neurologic outcome after cardiac arrest.
Methods: The design was a retrospective medical record review. The study took place in a tertiary-care university teaching hospital. Over a period of 22 months, all CA patients were included. No interventions were performed. Primary endpoint was survival after 24 h. The secondary endpoint was neurologic outcome at discharge based on a Cerebral Performance Categories (CPC) score.

Results: 671 cardiac arrest patients were included. In the multivariable analysis, lactate clearance 3 h post-cardiac arrest is a predictor of 24-h survival with an area under the curve of 0.89 (see ROC curve below). Of the 105 patients who had initial lactate values available, 13 survived with a good neurologic outcome (CPC 1 or 2).

Conclusion: Lactate clearance 3 h post-cardiac arrest is a predictor of 24-h survival.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.203

AP156

The National Early Warning (NEWS) score could not predict secondary transportation to the tertiary hospital in a Finnish prehospital care


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Purpose of the study: Unnecessary use of ambulances results in the overloading of the Emergency medical services (EMS) and the overcrowding of emergency departments. Medical assessment at the scene by EMS staff may reduce these issues and, moreover, help to recognize the need for the immediate higher level of care of the prehospital patients. The primary outcome measure of this study was direct transportation to a final hospital.

Materials and methods: The data was collected prospectively from all patients, over 18 years, treated by the EMS in a prehospital setting and transported to a local primary health care at Pirkanmaa district during June 2015. The national early warning score (NEWS) was retrospectively calculated on the basis of physiological observations at the scene, and the patients were categorized on the basis of the NEWS.

<table>
<thead>
<tr>
<th>Response codes (B%, C%, D%)</th>
<th>NEWS 0–4 N=880 (86%)</th>
<th>NEWS 5–6 N=64 (7%)</th>
<th>NEWS &gt;7 N=69 (7%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physician consulted by phone</td>
<td>19%</td>
<td>22%</td>
<td>28%</td>
</tr>
<tr>
<td>Transportation to the tertiary hospital; n (%)</td>
<td>149 (17%)</td>
<td>14 (22%)</td>
<td>10 (14%)</td>
</tr>
</tbody>
</table>

The chi-square test was used for comparisons between groups. Statistical significance level was set at $p < 0.05$ and two-tailed $p$-values were reported.

Results: A total of 40 ambulances participated to the study, and 933 missions were recorded over a month period. The majority were medical patients (82%) whose NEWS were scored 0–4 (86%). The median NEWS was 1. In a follow-up, 19% of those transported to the primary or secondary healthcare center were immediately transported to a tertiary-care hospital. Surprisingly, even with a high NEWS score, there were patients who were transported to the primary care, and only 14% of them were further transported to a tertiary-care hospital (Table 1).

Conclusions: Most patients were transported to the appropriate level of care evaluated by NEWS, but NEWS could not predict the transport to a secondary hospital.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.204

AP157

“The nomogram”; Visualization of probability for out-of-hospital cardiac arrest

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Purpose: Therapeutic hypothermia is a key component of treating arrest patients to reduce brain injury as AHA already recommends class I for out-of-hospital cardiac arrest survivors with ventricular fibrillation or pulseless ventricular tachycardia and class IIb for OHCA survivors with non-shockable rhythm or in-hospital cardiac arrest. However, many TH-related issues have yet to be sufficiently resolved. Emergency physicians always face a main question on the prognosis of resuscitated patients with ROSC.

The current reality is of an ambiguous prediction. However, if we use a nomogram, physicians can understand a probability that simultaneously considers various factors, not single odds ratio.

Method: The Korea Hypothermia Network managed a web-based retrospective registry of cases of OHCA treated with TH.

Adult (≥18 years) comatose patients treated with TH between January 2007 and December 2012 were included. Cases of cardiac arrest from trauma or stroke or those occurred in the hospital were excluded. We performed a logistic regression using prehospital variables of KORHN registry to predict a good neurologic outcome (CPC 1,2).

Result: According to selected logistic model by backward method, significant variables are previous CPC status, history of DM, presence of witness, shockable rhythm on scene and ED, time interval to ROSC and cause of arrest. We plot odds ratio based on selected model and draw a nomogram (Figs. 1 and 2) using R (R version 3.1.3).
Conclusion: We conclude that a nomogram could be an interesting visualization tool for physicians, and it shows that providing airway devices during transportation to ED might be discouraged.

Clearance of delta neutrophil index and lactate as a predictive marker in post-cardiac arrest

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Purpose: The post-cardiac arrest syndrome is associated with shock and systemic inflammatory response syndrome (SIRS). We speculate that lactate clearance (for hypo-perfusion indicator) and the delta neutrophil index (DNI) clearance (as the immature leukocyte sub-fractions for SIRS) may predict outcomes in post-cardiac arrest patients.

Materials and methods: This is a prospective observational study. Non-traumatic, adult cardiac arrest patients who survived for at least 24 h after return of spontaneous circulation (ROSC) and admitted to emergency intensive unit were included. Blood lactate and DNI levels were measured at T0 (immediately on ROSC) and T24 h (24 h after admission). We compared the initial levels and differences in the percent fraction of lactate and DNI over 24 h. The primary outcome was survival at hospital discharge, and secondary outcome was favourable neurological outcome.

Results: Of the 166 patients, 27 (16.3%) had an initial shockable rhythms. The overall rates for survival and favourable neurologic outcomes were 17.3% and 13.1%, respectively. In the shockable rhythm group, survivors and patients with good neurologic outcome had lower initial lactate level ($p = 0.027$), but not initial DNI ($p = 0.409$), lactate clearance ($p = 0.338$) and DNI clearance ($p = 0.176$). In the non-shockable rhythm group, favourable survival outcomes had higher DNI clearance ($p = 0.007$) and lactate clearance ($p = 0.017$), but not initial DNI ($p = 0.783$) and lactate ($p = 0.425$).

Conclusions: Higher DNI and lactate clearances are available parameters for 30-day survival outcomes after cardiac arrest with non-shockable rhythms. These findings suggest that early, effective goal therapy of both shock and SIRS plays an important role in post-cardiac arrest patients.

Public location and male gender, but not the duration of resuscitation attempt, predict cardiopulmonary resuscitation related injuries in out-of-hospital cardiac arrest

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7 Department of Intensive Care, Tampere University Hospital, Tampere, Finland

Purpose of the study: New guidelines emphasize the provision of high-quality cardiopulmonary resuscitation (CPR).1 Although CPR-related injuries in out-of-hospital cardiac arrest (OHCA) are considered unavoidable, they affect the performance and attitudes of emergency medical service (EMS) personnel towards compliance with CPR guidelines.2–4

We determined the frequency and severity of CPR-related injuries in OHCA and examined patient and event characteristics in an EMS system where patients are not routinely transported to hospital with ongoing CPR but, instead, where CPR was performed on the scene.

Material and methods: This observational study was conducted between 1.6.2013–31.5.2014 in Pirkanmaa, Finland. Data were col-
Data were analysed with chi-square test or Mann–Whitney U test. Binary logistic regression analysis was applied for ORs to determine predictors for CPR-related injuries. Statistical significance was defined as two-tailed \( p < 0.05 \).

Results: During the study period, 149 forensic autopsies were performed following an OHCA. Most common CPR-related injuries were multiple rib fractures (Table 1). Abdominal visceral injuries or injuries related to airway management were infrequent. Injuries were associated with older age, male gender, ventricular fibrillation as the initial rhythm, public location and any return of spontaneous circulation during a CPR attempt (Table 2). There was no difference in the duration of the CPR attempt between the injured and non-injured groups. Public location, male gender and older age were independent predictors of injuries (Table 3).

Table 1
Injuries related to cardiopulmonary resuscitation in out-of-hospital cardiac arrest.

<table>
<thead>
<tr>
<th>Injury</th>
<th>All patients n = 149</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sternum fracture n (%)</td>
<td>22 (15)</td>
</tr>
<tr>
<td>Rib fracture n (%)</td>
<td>64 (43)</td>
</tr>
<tr>
<td>Bilateral n (%)</td>
<td>51 (34)</td>
</tr>
<tr>
<td>Unilateral n (%)</td>
<td>6 (4)</td>
</tr>
<tr>
<td>≥2 fractures n (%)</td>
<td>63 (42)</td>
</tr>
<tr>
<td>≥4 fractures n (%)</td>
<td>56 (38)</td>
</tr>
<tr>
<td>≥6 fractures n (%)</td>
<td>47 (32)</td>
</tr>
<tr>
<td>≥8 fractures n (%)</td>
<td>33 (22)</td>
</tr>
<tr>
<td>Number of rib fractures, mean ± SD [min–max]</td>
<td>3.3 ± 4.7 [0–24]</td>
</tr>
<tr>
<td>Pneumothorax n (%)</td>
<td>0</td>
</tr>
<tr>
<td>Haemothorax n (%)</td>
<td>4 (3)</td>
</tr>
<tr>
<td>Haematoma–rib fractures n (%)</td>
<td>11 (0.7)</td>
</tr>
<tr>
<td>Lung contusion n (%)</td>
<td>1 (0.7)</td>
</tr>
<tr>
<td>Mediastinal haematoma n (%)</td>
<td>1 (0.7)</td>
</tr>
<tr>
<td>Great vessels n (%)</td>
<td>1 (0.7)</td>
</tr>
<tr>
<td>Haematoma–heart n (%)</td>
<td>11 (7)</td>
</tr>
<tr>
<td>Gastric rupture n (%)</td>
<td>1 (0.7)</td>
</tr>
<tr>
<td>Liver rupture n (%)</td>
<td>1 (0.7)</td>
</tr>
<tr>
<td>Spleen rupture n (%)</td>
<td>0</td>
</tr>
<tr>
<td>Laryngeal haematoma n (%)</td>
<td>2 (1)</td>
</tr>
</tbody>
</table>

Table 2
Out-of-hospital cardiac arrest patient characteristics divided into injured and non-injured groups.

<table>
<thead>
<tr>
<th>Injuries</th>
<th>Injured n= 365</th>
<th>Non-injured n= 365</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>n (%)</td>
<td>70 (47)</td>
<td>79 (53)</td>
<td>0.038</td>
</tr>
<tr>
<td>Age, mean ± SD [min–max]</td>
<td>70 ± 13.1</td>
<td>65 ± 16.8</td>
<td>0.003</td>
</tr>
<tr>
<td>Male, n (%)</td>
<td>56 (80)</td>
<td>45 (57)</td>
<td>0.003</td>
</tr>
<tr>
<td>BMI, mean ± SD [min–max]</td>
<td>27.8 ± 5.7</td>
<td>29.1 ± 8.2</td>
<td>0.627</td>
</tr>
<tr>
<td>Bystander CPR, n (%)</td>
<td>12 (17)</td>
<td>17 (22)</td>
<td>0.127</td>
</tr>
<tr>
<td>EMS witnessed n (%)</td>
<td>39 (56)</td>
<td>31 (39)</td>
<td>0.038</td>
</tr>
<tr>
<td>Duration of bystander CPR attempt, min ± SD [min–max]</td>
<td>10.6 ± 6.1</td>
<td>12.0 ± 7.9</td>
<td>0.411</td>
</tr>
<tr>
<td>Duration of EMS CPR attempt min ± SD [min–max]</td>
<td>23.0 ± 16.0</td>
<td>19.7 ± 12.6</td>
<td>0.232</td>
</tr>
<tr>
<td>Initial rhythm VF, n (%)</td>
<td>20 (29)</td>
<td>9 (11)</td>
<td>0.008</td>
</tr>
<tr>
<td>Initial rhythm PEA, n (%)</td>
<td>23 (33)</td>
<td>16 (20)</td>
<td>0.081</td>
</tr>
<tr>
<td>Airway management n (%)</td>
<td>26 (37)</td>
<td>9 (11)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>intubation, n (%)</td>
<td>21 (30)</td>
<td>14 (18)</td>
<td>0.078</td>
</tr>
<tr>
<td>Any ROSC, n (%)</td>
<td>15 (26)</td>
<td>6 (10)</td>
<td>0.020</td>
</tr>
</tbody>
</table>

BMI, body mass index; CPR, cardiopulmonary resuscitation; PEA, pulseless electrical activity; ROSC, return of spontaneous circulation; VF, ventricular fibrillation.

Conclusion: Public location and male gender, but not the duration of resuscitation attempt predicted CPR-related injuries in OHCA. Health-care professionals benefit from an understanding of the frequency and characteristics of CPR-related injuries in OHCA. This will help them to make better clinical decisions on OHCA patient care.

References

http://dx.doi.org/10.1016/j.resuscitation.2016.07.207

AP160
Cardiogenic arrest during acute hospital care happens earlier but ends better than non-cardiogenic arrest: A retrospective cohort study
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2 Department of Emergency Medicine, Lu tong Poh-Ai Hospital, Yilan County, Taiwan

Purpose of the study: Hospitalized patients with shockable cardiac arrest have been reported to have better survival than those with non-shockable rhythm. This study was aimed to evaluate the difference of cardiopulmonary resuscitation (CPR) and outcomes between cardiogenic and non-cardiogenic arrest among patients receiving acute hospital care at emergency room (ER).

Materials and methods: This retrospective study enrolled 365 patients with non-traumatic adult in-hospital cardiac arrest (IHCA) occurring in the ER of a tertiary medical centre in Taiwan from 2011 to 2014. Etiologies of cardiac arrests were classified into cardiogenic and non-cardiogenic based on history, initial rhythm, laboratory examinations and the findings of cardiac catheterisation/echocardiography when available. The epidemiology, CPR

| Predictor | CPR-related injuries | | p-value | Odds ratio | 95% CI | | CPR-related injuries | | p-value | Odds ratio | 95% CI |
|-----------|----------------------|---|---|---|---|---|---|---|---|---|---|---|
| Age       |                      |   |   | 0.012 | 1.04 | 1.00–1.07 | | 0.013 | 1.04 | 1.01–1.07 | |
| Gender    |                      |   |   | 0.001 | 4.11 | 1.79–9.43 | | 0.001 | 4.98 | 2.02–12.31 | <0.001 |
| BMI       |                      |   |   | 0.167 | Variable not entered | |   |   |   |   |   |   |
| CPR attempt |                |   |   | Variable not entered | |   |   |   |   |   |   |

CPR, cardiopulmonary resuscitation; ROSC, return of spontaneous circulation; VF, ventricular fibrillation.
events and outcomes between patients with cardiogenic and non-cardiogenic IHCA were compared.

**Results presented in sufficient detail to support the conclusions:** There were 119 patients (32.6%) with cardiogenic arrest and 246 patients (67.4%) with non-cardiogenic arrest; 67 patients (36.3%) with cardiogenic IHCA occurred within 4 h following triage as compared to 84 patients (34.2%) with non-cardiogenic IHCA ($p < 0.001$). There were 95 patients (79.8%) with cardiogenic arrest and 191 patients (77.6%) with non-cardiogenic arrest regaining return of spontaneous circulation (ROSC; $p = 0.634$). Between these two groups, there were no significant differences in the CPR duration (cardiogenic: 11.54 ± 13.8 min, non-cardiogenic arrest: 10.42 ± 8.97 min, $p = 0.475$) in successfully resuscitated patients. When compared with 44 patients (17.9%) in the non-cardiogenic group, 41 patients (34.5%) in the cardiogenic group survived to hospital discharge ($p < 0.001$). Among survivors, 29 patients (24.37%) in the cardiogenic group had good neurological outcome (cerebral performance category of 1 or 2), compared with only 21 patients (8.5%) in the non-cardiogenic group ($p < 0.001$).

**Conclusion:** During acute care at ER, cardiogenic arrest happens earlier than non-cardiogenic arrest. Patients with cardiogenic arrest have a higher survival-to-hospital-discharge rate and better neurological outcome.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.208

AP161

**Comparing effectiveness of video-assisted oral debriefing versus oral debriefing alone during human resuscitation simulation: A randomized trial**

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**Purpose of the Study:** Debriefing is an important key component of simulation-based medical education. As its optimal format is unknown, video-feedback may optimize the learning process. The purpose of the study was to evaluate the potential benefits of video-assisted oral debriefing (VAOD) versus oral debriefing alone (ODA) on candidates’ performance in a Basic Life Support with an Automated External Defibrillator (BLS/AED) scenario. We also evaluated the candidates’ perception about the usefulness of either debriefing.

**Materials and methods:** Ninety candidates (physicians and nurses) were enrolled in the study. After performing a pretest BLS/AED scenario, participants were randomized in two groups to receive a facilitated debriefing: either ODA or VAOD. Participants were then asked to complete a posttest BLS/AED scenario. Pre- and posttests were video recorded to allow a blinded independent reviewer to rate each participant’s skills in both tests, using the European Resuscitation Council (ERC) BLS/AED provider assessment record tool. Participants were then required to fill a validated questionnaire (Simulation Design Scale) in order to assess the usefulness of both debriefings.

**Results:** There was no significant difference in performance scores between the two groups in either pre- or posttests. BLS/AED resuscitation performance scores improved similarly in both groups [mean (SD), 64.7% (12%) for ODA pretests vs. 92.1% (6%) for ODA posttests ($P < 0.001$); 63.7% (11%) for VAOD pretests vs. 93.1% (10%) for VAOD posttests ($P = 0.005$)]. There was no significant difference in candidates’ perception about the usefulness of each type of debriefing [mean (SD), 84.4% (14%) for ODA vs. 88.8% (11%) for VAOD ($P < 0.001$)].

**Conclusions:** Using VAOD in human resuscitation simulation did not show any advantage over ODA and was not perceived by participants as more useful than ODA. However, our results suggested that the use of a debriefing process (either oral or video-assisted) offers a significant improvement in resuscitation skills.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.209

AP162

**Development of an interprofessional simulation-based in situ training program in paediatric emergencies**

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2 Department of Paediatrics and Adolescent Medicine, Graz, Austria

**Purpose of the study:** Traditional residency training may not provide sufficient learning opportunities to develop competence in essential clinical skills. 1 On the other hand, repetitive deliberate practice involving medical simulation is associated with improved learner outcomes. 2 Simulation-based training (SBT) not only results in improved practical performance, 3 but also has the potential to improve patient outcome. 4 Thus, we have implemented and evaluated a simulation-based in situ emergency training program aiming at physicians and nursing staff of a tertiary paediatric centre.

**Materials and methods:** SBT was delivered in situ either in the emergency outpatient clinic or at a hospital ward, being conducted by two physicians using a medium-fidelity paediatric patient simulator. Each session lasted for 30 min and included one physician and 1–2 paediatric nurses. Scenarios featured paediatric emergencies such as hypovolaemic shock, spastic bronchitis, seizures, and anaphylaxis. Following SBT, structured debriefing focused on both technical skills performance and non-technical skills such as teamwork behaviour, communication, and leadership.

All scenarios were video-recorded for objective assessment of trainee performance, with several items being rated on 5-point Likert-type scales (increasing numbers represent worse results). Results are given as mean ± 1 standard deviation.

**Results:** Between September 2015 and April 2016, 19 healthcare professionals including nine residents/fellows and ten paediatric nurses/nursing assistants participated. Video analyses showed satisfying performance: guideline conformity (1.3 ± 0.5), structured physical examination (2.0 ± 0.9), airway management (1.2 ± 0.4), fluency of workup (1.3 ± 0.5), team communication (1.4 ± 0.5) and leadership (1.4 ± 0.7).

**Conclusions:** We have successfully established an interprofessional simulation-based in situ training program at our institution, with training that involves common paediatric emergencies resulting in satisfying performance. As a next step, we will have to ensure delivery of SBT on a more regular basis.

**References**

**Introduciton:** Despite being at-least-as-good as ‘guideline’ CPR, automated-CPR (A-CPR) devices have not been able to improve outcomes in clinical trials.\(^1\)\(^2\) The A-CPR outcome is potentially negatively influenced by the persisting and extended time needed for set-up. Our aim was to investigate set-up times of A-CPR devices, both in training and real cases, and to determine the underlying factors.

**Methods:** We searched PUBMED for studies reporting clinical- or manikin-based trials for LUCAS (I/II)/AutoPulse set-up times. We analysed our clinical data over 2014–2015 for A-CPR set-up times. We also observed and scored our training sessions and confounders by surveying responsible team members.

**Results:** We identified 7 studies reporting set-up times for LUCAS (8 subgroups) and 10 for AutoPulse (16 subgroups). Set-up times including our own (25 of 40 LUCAS cases were found eligible) are summarized in [Fig. 1](#). Consistent differences between training and clinical trials were clothing hindrance: difficulty in closing clips to backboard; patient’s (higher and ‘dead’) weight: too little clearance on back-mattress); access to patient (IV-lines, cables and mattress itself) and initial malposition of the A-CPR backboard. Few studies report CRM-based issues. Team members almost unanimously reported that training poorly simulates reality: manikins are too light and their back is inflexible, clothing is never an issue and the arms are stiff and hinge poorly.

**Conclusion:** Set-up times for A-CPR devices still exceed the accepted hands-off time and thus potentially undo benefits. Training is currently oversimplified, and unsuitable because of inappropriate manikins and training scenario set-up. Instructors need to introduce common confounders.

**References**


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**AP167**

**Teaching A-CPR set-up strategy: Training poorly simulates reality**

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**Elisabeth-TweeSteden Hospital, Tilburg, The Netherlands**

**Introduction:** Teaching A-CPR set-up strategy: Training poorly simulates reality: manikins are too light and their back is inflexible, clothing is never an issue and the arms are stiff and hinge poorly.

**Methods:** We searched PUBMED for studies reporting clinical- or manikin-based trials for LUCAS (I/II)/AutoPulse set-up times. We analysed our clinical data over 2014–2015 for A-CPR set-up times. We also observed and scored our training sessions and confounders by surveying responsible team members.

**Results:** We identified 7 studies reporting set-up times for LUCAS (8 subgroups) and 10 for AutoPulse (16 subgroups). Set-up times including our own (25 of 40 LUCAS cases were found eligible) are summarized in [Fig. 1](#). Consistent differences between training and clinical trials were clothing hindrance: difficulty in closing clips to backboard; patient’s (higher and ‘dead’) weight: too little clearance on back-mattress); access to patient (IV-lines, cables and mattress itself) and initial malposition of the A-CPR backboard. Few studies report CRM-based issues. Team members almost unanimously reported that training poorly simulates reality: manikins are too light and their back is inflexible, clothing is never an issue and the arms are stiff and hinge poorly.

**Conclusion:** Set-up times for A-CPR devices still exceed the accepted hands-off time and thus potentially undo benefits. Training is currently oversimplified, and unsuitable because of inappropriate manikins and training scenario set-up. Instructors need to introduce common confounders.

**References**

Methods: The study included 12 emergency medical service MDTs comprising 4 members each (n = 48). Six MDTs underwent 9 simulations (experimental group) and 6 underwent 3 simulations (control group) over one year. SC was assessed by ELISA the day prior to simulation (T0), before simulation (T1), after simulation (T2), and after debriefing (T3). Variation in SC level over time was analyzed using repeated measures ANOVA. Mann–Whitney U test was used for comparison between the groups at two times, and Kruskal–Wallis test was used to study the stress response in the different status of teams. A p value <0.05 was considered significant.

Results: SC increased from 0.16 ± 0.12 (T0) to 0.26 ± 0.14 (T1). SC level continued to increase to 0.39 ± 0.27 at T2 before decreasing to 0.21 ± 0.12 at T3 (p < 0.0001). SC increase was found in all team members with no status effect. SC level was not blunt after repetition of sessions regardless of the frequency of sessions.

Conclusion: SC increased during immersive simulation, and this variation was not blunt after repetition of simulation sessions. No status effect was found among the MDTs’ members. Future study should investigate other markers of stress response and correlate them to team performance.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.213

AP167

Resuscitation after smoke inhalation with cyanide intoxication: An experimental approach

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2 Department of Neurosurgery, University of Giessen, Giessen, Germany
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Purpose of the study: Death by fire is mainly caused by toxic smoke inhalation.1 Resuscitation of fire victims may need specific antidote treatment.2 We designed a realistic animal model to investigate the effects of combined inhalation of the important toxic gases carbon monoxide (CO) and hydrogen cyanide (HCN). The objective of this study was to determine the feasibility and safety of this model and the effects of Advanced Life Support on Return of Spontaneous Circulation (ROSC).

Materials and methods: After receiving approval from the local authorities, a smoke inhalation model for pigs (25–35 kg) was designed with a closed ventilation circuit. Oxygen, compressed air, compressed air with CO (1500 parts per million (ppm)) and compressed air with HCN (1000 ppm) cylinders were connected together with valves, allowing a multiple mixture of gas concentrations to be supplied to a Siemens Servo300 ventilator. The expiratory outlet leads to a gas suction unit. Room-air concentrations were monitored with gas detection devices for CO and HCN. Twenty-four pigs (mean weight 31 kg) underwent anaesthesia, intubation and instrumentation. Inhalational intoxication was simulated by controlled ventilation with air with CO (1500 ppm) (5 min), followed by air with CO (750 ppm) and HCN (500 ppm) (5 min) and finally HCN (1000 ppm) until cardiac arrest occurred. Resuscitation was started with 100% oxygen and chest compressions (10 min), followed by ALS according to guidelines. Additionally, 5 g hydroxycoBALamin or placebo was given.

Results: No increase in room air concentration of CO/HCN could be observed. Cardiac arrest occurred in all pigs in a median time of 38 min (25.5/48.5). ROSC was achieved in 14/24 pigs (7 hydroxycoBALamin, 7 placebo), and the median time to ROSC was 14 min (13/15.8).

Conclusions: This smoke inhalation model was safe and lead to cardiac arrest in all cases. The time to cardiac arrest in this model was much longer than that reported in literature.1 Additional investigations are needed to re-evaluate the toxic effects of combined CO/HCN inhalation and resuscitation outcome.

References


http://dx.doi.org/10.1016/j.resuscitation.2016.07.215
Hydroxycobalamin improves oxygen uptake during resuscitation after smoke inhalation with cyanide intoxication

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Purpose of the study: Toxic smoke inhalation is often combined with intoxication of both carbon monoxide (CO) and hydrogen cyanide (HCN).1 Resuscitation of fire victims with cardiac arrest may be improved by specific antidote treatment.2,3 We investigated the influence of resuscitation using the antidote hydroxycobalamin on oxygen uptake in cardiac arrest following toxic smoke inhalation in an animal model.

Materials and methods: After receiving approval from the local authorities, an intoxication model for pigs (25–35 kg) with anesthesia, intubation and instrumentation including a pulmonary arterial catheter was used. Smoke inhalation was simulated by controlled ventilation in a closed circuit with air with CO (1500 parts per million (ppm)) for 5 min, followed by air with CO (750 ppm) and HCN (500 ppm) for 5 min, and finally with air with HCN (1000 ppm) until cardiac arrest occurred. The pigs were infused with 5 g hydroxycobalamin or placebo, and resuscitation was started with 100% oxygen and chest compressions for 10 min, followed by standard Advanced Life Support including defibrillation and intravenous epinephrine administration. Before intoxication (baseline) and after antidote-infusion (t=3 min and t=9 min) oxygen uptake (VO2) was calculated. Primary endpoint was change in oxygen uptake compared to the baseline (Wilcoxon test, results are expressed as median and 25/75 percentiles).

Results: Fourteen pigs were included in the study. The results were as follows: hydroxycobalamin (n=7): VO2 baseline 126 (111/152) ml/min; t=3 min 182 (161/343) ml/min, p=0.016 vs baseline; t=9 min 174 (152/237) ml/min, p=0.016 vs baseline. Placebo (n=7): VO2 baseline 146 (115/221) ml/min, t=3 min 132 (66/152) ml/min, p=0.07 vs baseline; t=9 min 138 (59/157) ml/min, p=0.16 vs baseline. Return of spontaneous circulation was achieved in 12/14 pigs (5 hydroxycobalamin, 5 placebo).

Conclusions: Early administration of hydroxycobalamin during resuscitation improved oxygen uptake in this smoke inhalation model. We assume that this is a direct sign for recovery of cellular respiration from HCN intoxication. Further investigations are needed to investigate the effects on tissue damage by this treatment.

References

http://dx.doi.org/10.1016/j.resuscitation.2016.07.217

Differential activation of c-Fos in the paraventricular nuclei of the hypothalamus and thalamus of the rat following myocardial infarction

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Purpose: c-Fos is highly used to detect pathogenesis in CNS disorders. We examined changes in c-Fos immunoreactivity in the paraventricular nuclei of the hypothalamus (PVNH) and paraventricular nucleus of the thalamus (PVNT) after myocardial infarction (MI) in rats.

Materials and methods: Infarction in the left ventricle was examined by Masson's trichrome staining. Neuropathological damage (damage/death) was examined by 56 days after MI using cresyl violet (CV) and Fluoro-Jade B (F-J B) histofluorescence staining. Changes in c-Fos immunoreactivity were examined by immunohistochemistry.

Results: The average infarct size of the left ventricle circumference was about 44% after MI. Neuronal damage/death was not detected in both PVNH and PVNT after MI. c-Fos immunoreactive (+) cells were hardly found in both nuclei of the sham group. However, in the experimental group, c-Fos+ cells were increased in both nuclei after MI and peaked in the PVNH and PVNT 3 days and 14 days, respectively, after MI. At 56 days after MI, c-Fos+ cells were barely found in both nuclei.

Conclusion: These results show that MI dramatically induced c-Fos immunoreactivity in the PVNH and PVNT and suggest that the increase in c-Fos expression may be associated with brain stress related to MI.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.217
Materials and methods: The animals were randomly assigned to sham, ischemia, sham plus (+), RIPoC and ischemia + RIPoC groups. RIPoC was induced by three cycles of 5 min and 10 min occlusion-reperfusion of both femoral arteries at predetermined time points (0, 1, 3, 6, 12 and 24 h after transient cerebral ischemia). CV staining, F-J B histofluorescence staining and NeuN immunohistochemistry were carried out to examine neuroprotection in the RIPoC-mediated hippocampus 5 days after ischemia-reperfusion.

Results: In the ischemia group, we found a significant loss of pyramidal neurons in the stratum pyramidale (SP) of the hippocampal CA1 region at 5 days post-ischemia compared with the sham group. In the ischemia + RIPoC group, the loss of pyramidal neurons in the CA1 region at 5 days post-ischemia was not different from that in the ischemia group.

Conclusion: Our present findings indicate that RIPoC does not prevent hippocampal CA1 pyramidal neurons from neuronal death induced by transient cerebral ischemia.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.218

AP171

Hyperthermic preconditioning severely accelerates neuronal damage in the gerbil ischemic hippocampal dentate gyrus by decreasing SOD expression

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Purpose: It is well known that neurons in the dentate gyrus (DG) of the hippocampus are resistant to short period of ischemia. Hyperthermia is a proven risk factor for cerebral ischemia and can produce more extensive brain damage and is related to mortality rates. The aim of this study was to examine the effect of hyperthermic conditioning (H) on neuronal death and gliosis and expression of SODs as anti-oxidative enzymes in the gerbil DG following 5-min transient cerebral ischemia.

Materials and methods: The animals were randomly assigned into 4 groups: (1) (N+sham)-group was given sham operation with normothermia (N); (2) (N+ischemia) group was given 5-min transient ischemia with N; (3) (H+ sham) group was given sham-operation with H; (4) (H+ ischemia) group was given 5-min transient cerebral ischemia with H. H (39 ± 0.5 °C) was induced by subjecting the animals to a heating pad for 30 min before and during the operation. In the (N+ischemia)-groups, a significant neuronal death was observed in the polymorphic layer (PL) from 1 day after ischemia-reperfusion.

Results: In the (H+ischemia) group, neuronal death was also observed in the PL from 1 day post-ischemia; the degree of the neuronal death was severer than that in the (N+ischemia) groups. In addition, we examined the gliosis of astrocytes and microglia using anti-glial fibrillary acidic protein (GFAP) and anti-ionized calcium-binding adapter molecule 1 (Iba-1). GFAP+ and Iba-1+ glial cells were much more activated in the (H+ischemia) groups than in the (N+ischemia) group. On the other hand, immunoreactivities and levels of SOD1 rather than SOD2 were significantly lower in the (N+ischemia) groups than in the (N+ischemia) group.

Conclusion: In brief, based on our findings, we suggest that cerebral ischemic insult with hyperthermic conditioning causes severe neuronal damage and gliosis in the polymorphic layer through reducing SOD1 expression rather than SOD2 expression in the DG.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.219

AP172

Pre- and post-treatments with hydroquinone protect against experimental transient focal ischemia by attenuation of blood-brain barrier disruption

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Purpose: Hydroquinone (HQ), a major benzene metabolite, occurs naturally in various plants and is manufactured for commercial use. Although HQ shows various biological effects, its neuroprotective effects following ischemic insults have not been investigated.

Materials and methods: In this study, we first examined neuroprotective effects of HQ in a rat model of transient focal cerebral ischemia.

Results: Neuroprotection by pre- and post-treatments with 100 mg/kg of HQ was shown by evaluation of neurological deficits, PET (Positron emission tomography) and TTC (2,3,5-triphenyltetrazoliumchloride) staining. In addition, HQ treatment significantly attenuated ischemia-induced Evans blue dye extravasation from blood vessels and significantly increased immunoreactivities of SMI-71 (an endothelial BBB marker) and glucose transporter-1 (GLUT-1, an endothelial cell marker) in the ischemic cortex compared to the vehicle-treated ischemia-operated group. Confocal microscopy and western blot analysis also showed that HQ treatment maintained expressions of tight junction proteins (zonula occludens-1 and occludin) in the ischemic cortex.

Conclusion: Briefly, our results indicate that pre- and post-treatments with HQ protect neurons from transient focal cerebral ischemic injury, and the neuroprotective effect of HQ may be closely associated with prevention of BBB disruption by maintaining SMI-71 and GLUT-1 expression as well as prevention of the degradation of zonula occludens-1 and occludin proteins.

Keywords: Hydroquinone; Ischemic stroke; Neuroprotective effects; Blood–brain barrier; Tight junction

http://dx.doi.org/10.1016/j.resuscitation.2016.07.220
AP173

Neuroprotection of ischemic preconditioning is mediated by thioredoxin 2 in the hippocampal CA1 region following a subsequent transient cerebral ischemia

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Purpose: Preconditioning by brief ischemic episode induces tolerance to a subsequent lethal ischemic insult, and it has been suggested that reactive oxygen species are involved in this phenomenon. Thioredoxin 2 (Trx2), a small protein with redox-regulating function, shows cytoprotective roles against oxidative stress.

Materials and methods: Here, we focused on the role of Trx2 in ischemic preconditioning (IPC)-mediated neuroprotection against oxidative stress followed by a subsequent lethal transient cerebral ischemia. IPC was subjected to a 2 min of sublethal transient ischemia 1 day prior to a 5 min of lethal transient ischemia.

Results: A significant loss of neurons was found in the stratum pyramidale (SP) of the hippocampal CA1 region (CA1) in the ischemia-operated group 5 days after ischemia-reperfusion; in the IPC + ischemia-operated group, pyramidal neurons in the SP were well protected. In the IPC + ischemia-operated group, Trx2 and TrxR2 immunoreactivities in the SP and its protein level in the CA1 were not significantly changed compared to those in the sham-operated group after ischemia-reperfusion. In addition, superoxide dismutase 2 (SOD2) expression, superoxide anion radical (O2•−) production, denatured cytochrome c expression and TUNEL-positive cells in the IPC + ischemia-operated group were similar to those in the sham-operated group. On the other hand, auranofin treatment of the IPC + ischemia-operated group significantly increased cell damage/death and abolished the IPC-induced effect on Trx2 and TrxR2 expression. Furthermore, the inhibition of Trx2R nearly cancelled the beneficial effects of IPC on SOD2 expression, O2•− production, denatured cytochrome c expression and TUNEL-positive cells.

Conclusion: In brief, this study show that IPC conferred neuroprotection against ischemic injury by maintaining Trx2 and suggests that the maintenance or enhancement of Trx2 expression by IPC may be a legitimate strategy for therapeutic intervention of cerebral ischemia.

Keywords: Ischemia-reperfusion; Oxidative stress; Delayed neuronal death; Thioredoxin 2; Superoxide dismutase 2; Superoxide anion

http://dx.doi.org/10.1016/j.resuscitation.2016.07.221

AP174

Prehospital deaths from trauma: Are injuries survivable and do bystanders help?

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Background and Objectives: Deaths from trauma occurring in the prehospital phase of care are typically excluded from analysis of trauma registries. 1 The paucity of research into these deaths is a major limitation to prehospital care. A direct historical comparison with Hussain’s and Redmond’s 2 study on preventable prehospital deaths from injury has shown that, two decades on, the number of potentially preventable deaths remains high, despite advances in trauma systems and care. Using updated methodology, we aimed to determine the nature, injury severity and survivability of traumatic prehospital deaths to improve understanding and identify potential interventions for better patient outcomes.

Methods: We examined the Coroners’ inquest files for deaths occurring in the prehospital phase of care from trauma or accidental injury over a 3-year period in the Cheshire and Manchester (City) Coronial jurisdictions. Injuries were scored using the Abbreviated-Injury-Scale (AIS 2008). Injury Severity Score (ISS) was calculated, and the probability of survival was estimated using the Trauma Audit Research Network’s outcome prediction model.

Results: A total of 178 deaths were included in the study (134 Cheshire, 44 Manchester (City)). The World Health Organisation’s recommendations consider those with a probability of survival between 25–50% as potentially preventable and those above 50% as preventable. The average ISS was 30 (Cheshire) and 35 (Manchester (City)) with 45% and 59%, respectively, having a probability of survival in the potentially preventable and preventable range. Bystander presence on scene, during or immediately after the point of injury was 44.7% (Cheshire) and 38.6% (Manchester (City)). Bystander intervention of any kind was 24.6% and 29.5%, respectively.

Conclusions: A high number of prehospital deaths from trauma occur with injuries that are potentially survivable, yet first aid intervention is infrequent. Following injury, there is a potential window of opportunity for the provision of bystander assistance, prior to the arrival of EMS, for simple first-aid manoeuvres to save life. 3

References


http://dx.doi.org/10.1016/j.resuscitation.2016.07.222
The European Trauma Course development from 2006 to 2015

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Introduction: The European trauma course was developed in the pilot phase between 2006 and 2008. A group of experts from all over Europe designed it because it was necessary to create a flexible course on trauma management that can be used in all the different systems in Europe. Additionally, working in a team is not included in the available traditional courses. The goal was to create a course that focuses on team approach and is flexible to adapt to local protocols. On the basis of up-to-date adult learning models, 85% is practical simulation-based team training.

Material and methods: A database search of the ERC course database {courses.erc.edu} was performed. Data were shown according to country and month of the course.

Results: The courses started in 2006 with an inaugural course in Malta followed by 3 pilot courses. Subsequently, there were courses in 2008 (3), 2009 (11), 2010 (17), 2011 (18), 2012 (34), 2013 (41) and 2014 (62) in 3 (2008), 8 (2009), 10 (2010, 2011), 11 (2012), 13 (2013), 17 (2014) and 19 countries in 2015. The most courses were conducted in Germany (51), followed by Austria (37), UK (36), Egypt (28), Italy (21), Croatia (11), Malta (10), Poland (8), Slovenia (7), Portugal (6), Belgium, Finland, Denmark (5), Hungary (4), Saudi Arabia, Sudan, Sweden, Switzerland and Romania (3), Jordan (2) and Norway, Netherlands, Ireland and Greece (1).

Conclusion: The project “European Trauma Course” was piloted with four courses and started in 2008. The courses are already available in 24 countries and were quickly developed from 2008 to 2015 [1].

Reference

http://dx.doi.org/10.1016/j.resuscitation.2016.07.223

Lightning mass casualty incident with a successful CPR

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Introduction: Mass casualty incidents (MCIs) are characterized by greater demand for medical care than available resources. CPR is not usually initiated in MCI to avoid delaying potentially effective treatment for salvageable victims. Lightning MCIs are very rare, usually affecting small groups of tourists. Patients struck by lightning are most likely to die without immediate cardiac or respiratory support. If CPR is needed, resuscitative attempts may have higher success rates in lightning victims than in patients with cardiac arrest from other causes.

This case report shows a lightning MCI during a Holy Mass attended by 500 people with two CPRs.

Materials and methods: On 25 July, 2015, during a Holy Mass under the sky, the lightning hit a tree under which people were praying. Nine people were injured and were moved inside the church. Six were unconscious but breathing, while one had cardiac arrest. Lay CPR was started.

Results: Until the first EMS unit arrived, one patient was triaged black because of a massive bleeding from the lungs and ears and CPR effort was stopped. Meanwhile, another unconscious patient developed cardiac arrest. The actual resources were evaluated, and ALS was started immediately. ROSC occurred after 25 min of CPR, and the patient was transported to the hospital. After 3 days, he was discharged home with CPC1.

Conclusions: Though CPR is seldom started in MCIs, the organization of medical care on the scene during this MCI allowed enough facilities to start CPR. This is in line with the ERC 2015 Guidelines for lightning injury, as rescuers should give highest priority to patients in respiratory or cardiac arrest after the lightning injury. This decision proved to be a benefit to the above-mentioned patient as he developed ROSC, and is presently suffering only from mild consequences in the form of myalgia and chronic fatigue.

Reference

http://dx.doi.org/10.1016/j.resuscitation.2016.07.224

Are prehospital deaths from trauma and accidental injury preventable? A direct historical comparison to assess what has changed in two decades

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Background and objectives: In 1994, Hussain and Redmond revealed that up to 39% of prehospital deaths from accidental injury might have been preventable had basic first-aid care been given. Since then, there have been significant advances in trauma systems and care, but the current exclusion of prehospital deaths from the analysis of trauma registries is a limitation to prehospital research. We aimed to repeat the study in order to identify any changes and consider potential developments to improve patient outcomes.

Methods: We examined the full Coroner’s inquest files for prehospital deaths from trauma and accidental injury over a 3-year period in Cheshire. Injuries were scored using the Abbreviated-Injury-Scale (AIS1990), Injury Severity Score (ISS) was calculated and the probability of survival was estimated using Bull’s probits to match the original protocol.

Results: A total of 134 deaths met our inclusion criteria; 79% were male, average age at death was 53.8 years. 62 were found dead (FD), 58 died at scene (DAS) and 14 were dead on arrival
References

5. Localization of emergency services for imaging has gained importance once again the importance of exposure, especially in the axilla and groin, to the emergency physicians need to be reminded that we need to not lose sight of the joint seams in the junctional injuries.

Conclusions: The number of potentially preventable prehospital deaths remains high and unchanged. First-aid intervention of any kind is infrequent. There is a potentially missed window of opportunity for bystander intervention prior to the arrival of the EMS, with simple first-aid manoeuvres to open the airway, preventing hypoxic brain injury and cardiac arrest.3

AP178
The emergency room management in cities with terrorist attacks
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Aim: According to the data on global terrorism, in our world, 1970–2014 in between than 58,000 of the bombing was faced with terrorist attacks 140,000.1

According to a meta-analysis of Edwards et al., the most common primary injury was tympanic membrane injury, while the most common secondary injury was injury of the extremities (in the recent three terror attacks in cities of Turkey, injuries caused by gunshot wounds were observed more in people undergoing intensive emergency services than injuries caused by handmade explosives.2,3

Materials and methods: From April to May 2016, data were obtained from Nusaybin where 220 people were injured as a result of terrorist attacks and admitted to the hospital.

Results:

1. According to the social media, the emergency team of experts in the region mediated the treatment and resuscitation of the injured people, leading to high survival rate.
2. The use of CPR by ECMO was extremely successful.
3. In the succession of the hot zone of security guards at the entrance to the emergency room of ammunition still needs to be done by the technical team control.
4. The tympanic membrane should be checked routinely in the secondary care.
5. Localization of emergency services for imaging has gained importance again. Tomography and other direct radiography equipment should be readily accessible in the emergency department.
6. Injured person to emphasize once again the importance of exposure, especially in the axilla and groin, to the emergency physicians need to be reminded that we need to not lose sight of the joint seams in the junctional injuries.

Conclusion: Social networks offered an effective and fast [4] intervention for the successful treatment of victims of Nusaybin terrorist attacks. This technology does not allow the city to battle emergencies as a paradox.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.225

AP179
Injury characteristics in 2016 Taiwan Earthquake: Did the height of residence really matter?

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Background: An earthquake struck Taiwan on February 6, 2016, and resulted in the collapse of buildings and significant injuries. We sought to evaluate the injury characteristics of patients who lived at different heights in buildings.

Methods: A retrospective analysis was conducted using the Tainan incident registry system. The residents in a 16-floored (49 m in height), pancake-pattern collapsed building were divided into the high group (defined as more than the 10th floor or 30 m in height) and the low group. Injury characteristics were analysed by reviewing the prehospital documents and hospital charts.

Results: A total of 306 persons (age 0.5–87.0, mean 32.0 ± 18.0 years; male 51.8%) were enrolled, which consisted of 95.0% of the building residents (n = 322). The high group (n = 119, 38.9%; age 0.5–68.0, mean 31.6 ± 18.2 years; male 51.6%) and the low group (n = 187, 61.1%; age 0.5–75.0, mean 31.6 ± 17.9 years; male 51.9%) had no significant differences in out-of-hospital cardiac arrests (n = 51, 42.9% vs. n = 64, 34.2%; p = 0.15), injuries that required treatment in healthcare facilities (n = 42, 49.0% vs. n = 71, 54.7%; p = 0.72) or injuries not requiring treatment in healthcare facilities (n = 26, 21.8% vs. n = 52, 27.8%; p = 0.28). For those injuries requiring treatment in healthcare facilities, the high and low groups had no significant difference in triage acuities (severe, intermediate, mild:
19.0%, 47.6%, 33.4% vs. 15.5%, 43.7%, 40.8%, respectively; \( p = 0.71 \), injury severity scores (range 0–22, mean 5.2 ± 6.0 vs. range 0–18, mean 3.9 ± 3.9; \( p = 0.25 \)), head injuries (51.5% vs. 44.4%; \( p = 0.38 \)) chest injuries (24.2% vs. 28.9%; \( p = 0.65 \)), abdomen injuries (18.2% vs. 6.7%; \( p = 0.12 \)) or lower limb injuries (51.5% vs. 66.7%; \( p = 0.18 \)). Compared to the low group, the high group, had significantly less upper limb injuries (42.4% vs. 66.7%; \( p < 0.05 \)).

**Discussions and conclusions:** In 2016 Taiwan earthquake, the injury characteristics of residents in the high floors were similar to those in the low floors. These findings may provide important information for medical response in the future.

http://dx.doi.org/10.1016/j.resuscitation.2016.07.227