Short paper

Bystander performance using the 2010 vs 2015 ERC guidelines: A post-hoc analysis of two randomised simulation trials

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Abstract

Background: The European Resuscitation Council (ERC) basic life support (BLS) 2015 guidelines were simplified compared to the 2010 guidelines. We aimed to compare BLS/automated external defibrillator (AED) skill performance and skill retention following training with the 2010 or 2015 BLS/AED guidelines.

Methods: Post-hoc analysis of two randomised simulation trials including videorecordings of laypersons skill-tested after ERC BLS/AED training using either the 2010 ($n=70$) or 2015 ($n=70$) BLS guidelines. Outcomes: (a) correct sequence of the BLS/AED algorithm, (b) correct sequence of the BLS/AED algorithm with all skills performed correctly, and (c) time to EMS call, first chest compression and shock delivery immediately after training and three months later. Groups were compared using multivariate logistic regression.

Results: Mean age ($\pm$standard deviation) was 40 ($\pm$11) vs. 44 ($\pm$11) years and 70% vs. 50% were females for the 2010 and 2015 groups, respectively. Correct sequence of the BLS/AED algorithm for the 2010 vs. 2015 group was 84% vs. 91%, $P=0.08$ immediately after training and 16% vs. 41%, adjusted odds ratio (aOR): 5.6 (95% CI: 2.3−14.0, $P<0.001$) after three months. Correct sequence with all skills performed correctly was 56% vs. 47%, $P=0.31$ immediately after training and 5% vs. 16%, aOR: 4.8 (95% CI: 1.2−19.2), $P=0.03$ after three months. Time to EMS call was shorter in the 2015 group immediately after training ($P=0.008$) but all other time points did not differ.

Conclusion: The simplified 2015 BLS guidelines was associated with better adherence to the sequence of the BLS/AED algorithm when compared to the 2010 BLS guidelines three months after training in a simulated cardiac arrest scenario, without significantly improving skill performance immediately after training.

Keywords: Basic life support, Cardiopulmonary resuscitation, Out-of-hospital cardiac arrest, Quality of health care/standards, Education, Cardiopulmonary resuscitation/standards

Introduction

Resuscitation guidelines are intended to guide and align clinical practice based on available evidence. Additionally, guidelines should be simple and easy to follow, especially for laypersons, without compromising cardiopulmonary resuscitation (CPR) quality. Studies have shown that despite completion of basic life support (BLS)/ automated external defibrillator (AED) training, laypersons struggle to adhere adequately to guidelines when performing BLS with use of an AED.[1−7] Some difficulties lie in recognising a cardiac arrest and adhering to the BLS/AED algorithm.[3−5] Other common challenges among laypersons are correct placement of AED electrodes and achieving adequate CPR quality.[1,2,4−7]

Recommendations on resuscitation are reviewed and updated by the International Liaison Committee on Resuscitation (ILCOR).[8,9] These recommendations are adapted into guidelines by, e.g. the American Heart Association (AHA) and the European Resuscitation Council (ERC) to instruct rescuers on how to perform optimal CPR.[10,11] Compared to the ERC 2010 BLS guidelines, a simplified algorithm was published in the 2015 BLS guidelines by omitting shout for help prior to assessment of breathing (Fig. 1).[11,12] Simplifying the guidelines may potentially improve adherence to guidelines and reduce delays until key features of BLS: emergency medical services (EMS) call, initiation of chest compressions and shock delivery.

The aim of this study was to compare BLS/AED performance and skills retention among laypersons after training with either the ERC 2010 or 2015 BLS guidelines.

Methods

Study design

This is a post-hoc analysis conducted on two randomised simulation trials. The first study (142 participants: 70 in the control group, 72 in the intervention group) compared a standard ERC BLS/AED course using the ERC 2010 guidelines with a modified course using a two-stage teaching technique.[13,14] The second study (186 participants: 94 in the control group, 92 in the intervention group) compared a standard ERC BLS/AED course using the ERC 2015 guidelines with a modified course using Rapid Cycle Deliberate Practice (unpublished). The control group from each study receiving a standard ERC course were included to compare BLS/AED skill-performance and -retention of laypersons following the ERC 2010 guidelines and ERC 2015 guidelines. The standard ERC courses included BLS and AED training (duration: 3h 45min) using Peyton's 4-step approach.[13,15] Certified ERC BLS/AED instructors conducted the training with group sizes of 4 −6 using identical manikins and AED trainers for both training and testing (below). The teaching instructions on BLS/AED performance were identical in the two studies apart from a small change in the sequence algorithm in the 2015 guideline group.

We included 70 consecutive participants from each study. The participants were tested immediately after training and three months later. In conformity with the Danish National Committee on Biomedical Research Ethics, no ethical review committee approval was required for either the original or this study. Verbal and written consent were obtained from all participants in the original studies.
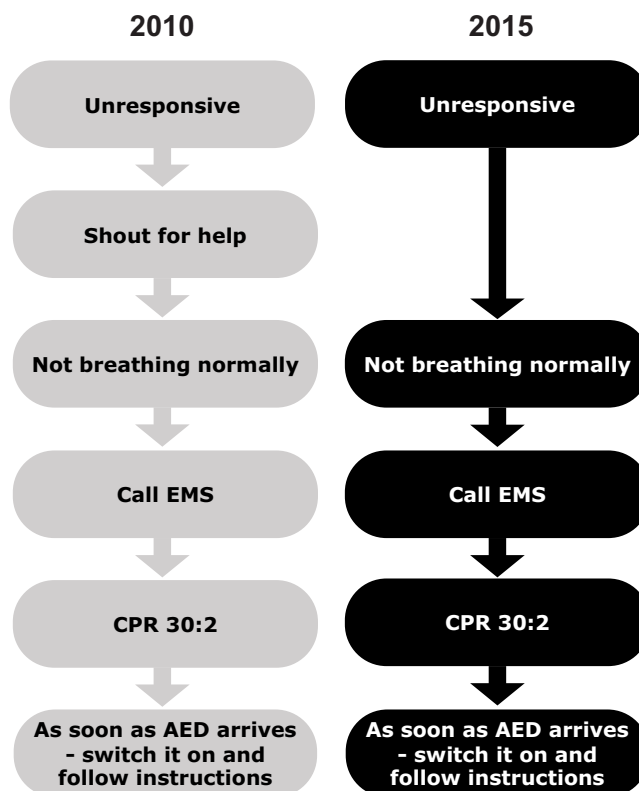
Fig. 1 – Sequence of actions for the European Resuscitation Council 2010 vs. 2015 basic life support guidelines. EMS: emergency medical services. CPR: cardiopulmonary resuscitation. AED: automated external defibrillator.
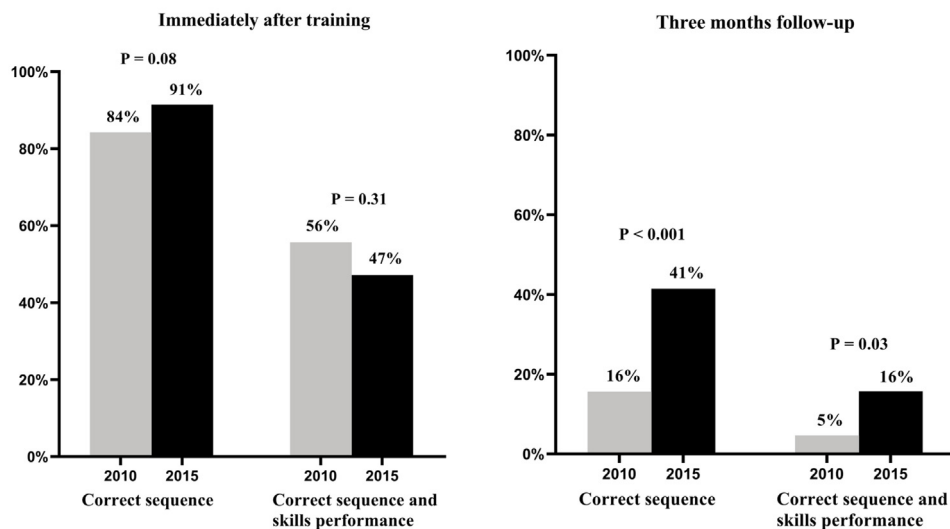
Participants

In both studies, participants were voluntary adult (≥18 years) laypersons from companies in the Central Denmark Region. The companies were contacted by phone and email, whereafter they invited their employees to attend the BLS/AED course. No financial incentives were offered. In the first study, participants were recruited between December 2012 and March 2013: in the second, between February 2018 and April 2018. Comparable exclusion criteria were used in both studies: holding a BLS instructor certificate or similar qualifications, having a health care education (e.g. physicians, nurses, physiotherapists etc.), and having completed BLS training within the last two years (2010 group) and within the last year (2015 group). Data on sex and age were obtained from a questionnaire in both studies.
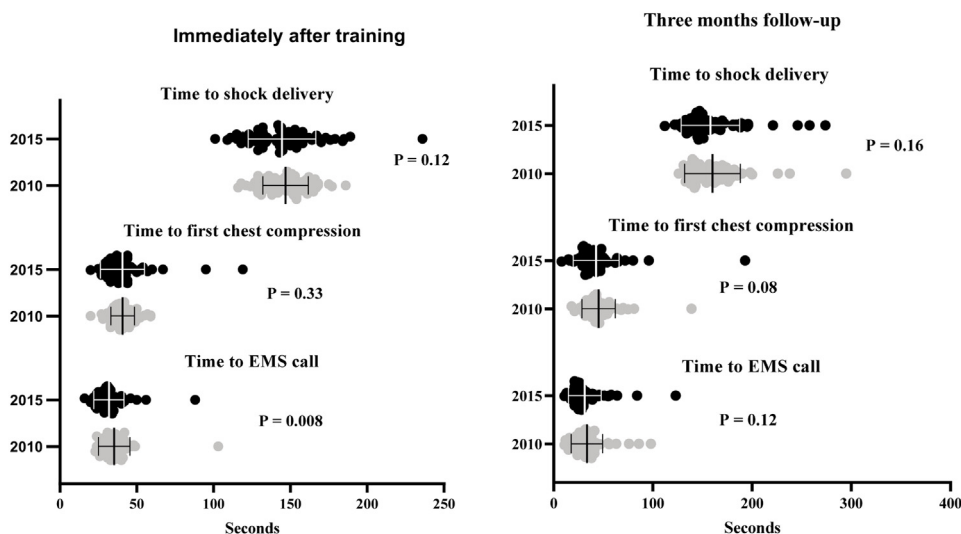
Test scenario

Participants were tested immediately after the courses and three months later in a simulated cardiac arrest scenario to assess acquisition and retention of BLS/AED skills. Resuscitation manikins (AMBU® Man C, AMBU, Ballerup, Denmark), AED-trainers (Lifepak CR Plus AED-trainer, Physio Control, Redmond, WA, USA) and test scenarios were identical in the two studies. The tests were recorded on video.

Fig. 2 – Comparison of participant performance (A) and time to emergency medical services (EMS) call, first chest compression, and shock delivery (B) for the European Resuscitation Council (ERC) 2010 and 2015 BLS guidelines, respectively. Median (Q1:Q3) time to EMS call was 34 (30:39) seconds vs 31 (26:35) seconds immediately after training and 32 (25:39) seconds vs 27 (23:33) seconds after three months. The median time to first chest compression was 40 (36:46) seconds vs 38 (33:43) seconds immediately after training and 43 (37:50) seconds vs 39 (34:47) seconds after three months. Shock delivery was 148 (136:157) vs 144 (131:154) seconds immediately after training and 155 (142:172) vs 149 (140:167) seconds after three months.

A standardised scenario was presented to participants stating that a person had collapsed in front of them. An instructor acted as a bystander who was unable to perform BLS/AED but was able to summon the EMS and obtain an AED if asked to do so. No feedback was given during or after the tests. In both studies, an AED was handed to the participant after 1.5 cycles of CPR (30:2) regardless of when or whether the participant asked for an AED. The tests were ended after completing two cycles of CPR after shock delivery in the first study, after three cycles in the second.

Skills assessment and test measurements

The outcomes were (a) correct sequence of the BLS/AED algorithm, (b) correct sequence of the BLS/AED algorithm with correct performance of all skills, and (c) time to EMS call, first chest compression, and shock delivery. Time outcomes were measured from when the participant touched the manikin. All videos were analysed according to the ERC assessment record and entered into a spreadsheet by one of the researchers.

Statistics

Data were analysed for normality using histograms and quantile−quantile plot analysis. Non-normally distributed data are presented as median (1st quartile; 3rd quartile), and normally distributed data are presented as mean±standard deviation (SD). To account for some of the potential confounding, we compared time outcomes using multivariate regression modelling with adjustment for age and sex. Proportions of participants adhering to the BLS sequence and performing all skills correctly were compared using multivariate logistic regression modelling with adjustment for age and sex and adjusted odds ratios (aOR) are reported. Data were analysed using Stata version 13.0 (StatsCorp LP, College Station, TX, USA). A P-value < 0.05 was considered as statistically significant.

Table 1 – Number of participants performing each step correctly in a skill test (A) immediately after training and (B) three months after training when following the European Resuscitation Council 2010 vs. 2015 basic life support guidelines. * Unadjusted analyses using the Chi-Square test. EMS: emergency medical services. AED: automated external defibrillator. CI: confidence interval. Basic life support skills.

Skills performed correctly	2010 (n=70)	2015 (n=70)	P-value
(A) *Immediately after training*			
Ensure safety (2010)	68 (97)	NA	
Check responsiveness − gently shaking and shouting	67 (96)	69 (99)	0.22
Shout for help (2010)	70 (100)	NA	
Assess breathing − perform head tilt and chin lift	68 (97)	64 (91)	0.39
Assess breathing − look, listen and feel for normal breathing	70 (100)	65 (93)	0.02*
Call EMS − instruct someone to phone 112 (the EMS number) to inform on the cardiac arrest	61 (87)	59 (84)	0.95
Chest compressions − 30±2 chest compressions per cycle with proper hand position, rate, and depth	69 (99)	67 (96)	0.66
Rescue breaths − 50% of rescue breaths sufficient to cause visible chest rise; no more than two ventilations attempt per cycle	58 (83)	63 (90)	0.17
Compression: ventilation ratio − 30:2	68 (97)	70 (100)	0.15*
Activate AED − switch the AED on	70 (100)	70 (100)	1*
Attach pads in correct position	69 (99)	68 (97)	0.52
Safe rhythm analysis	61 (87)	58 (83)	0.78
Safe shock delivery	61 (87)	58 (83)	0.78
Follow AED instructions	60 (86)	56 (80)	0.62
Sequence in correct order	59 (84)	64 (91)	0.08
Skills performed correctly	**2010 (n=64)**	**2015 (n=70)**	**P-value**
(B) *Three months follow-up*			
Ensure safety (2010)	48 (75)	NA	
Check responsiveness − gently shaking and shouting	47 (73)	60 (86)	0.02
Shout for help (2010)	63 (98)	NA	
Assess breathing − perform head tilt and chin lift	43 (67)	26 (37)	0.003
Assess breathing − look, listen and feel for normal breathing	61 (95)	61 (87)	0.24
Call EMS − instruct someone to phone 112 (the EMS number) to inform on the cardiac arrest	42 (66)	56 (80)	0.04
Chest compressions − 30±2 chest compressions per cycle with proper hand position, rate, and depth	62 (97)	65 (93)	0.35
Rescue breaths - 50% of rescue breaths sufficient to cause visible chest rise; no more than two ventilations attempt per cycle	51 (80)	61 (87)	0.19
Compression: ventilation ratio − 30:2	53 (83)	57 (81)	0.51
Activate AED − switch the AED on	64 (100)	70 (100)	1*
Attach pads in correct position	53 (83)	62 (89)	0.05
Safe rhythm analysis	40 (63)	53 (77)	0.06
Safe shock delivery	41 (63)	44 (63)	1
Follow AED instructions	33 (52)	48 (69)	0.02
Sequence in correct order	10 (16)	29 (41)	<0.001

Results

We included a total of 140 participants trained using either the 2010 (*n*=70) or 2015 (*n*=70) BLS guidelines. In total, six participants were lost to follow up in the 2010 group; none were lost to follow-up in the 2015 group. Baseline characteristics were fairly balanced between groups: mean age (±standard deviation) was 40 (±11) years vs. 44 (±11) years, and the proportion of females was 70% (49/70) vs. 50% (35/70) for the 2010 group and 2015 group, respectively.

Immediately after training, there was no significant difference between the 2010 and 2015 groups in the rate of the correct sequence of BLS/AED algorithm (84% vs 91%, aOR: 2.8 (95% CI: 0.9−8.8), *P*=0.08) and in the rate of correct sequence of BLS/AED algorithm with correct performance of all skills (56% vs 47%, aOR: 0.7 (95% CI: 0.4−1.4), *P*=0.31) (Fig. 2A). The number of participants performing each individual BLS/AED skill correctly is shown in Table 1. Time to EMS call was shorter in the 2015 group compared to the 2010 group, but there was no significant difference between groups in time to first compression or shock delivery (Fig. 2B).

At the three months follow-up, more participants in the 2015 group remembered the correct sequence of the BLS/AED algorithm compared to the 2010 group (41% vs 16%, aOR: 5.6 (95% CI: 2.3 −14.0), *P*<0.001), and more participants in the 2015 group remembered the correct sequence of the BLS/AED algorithm with correct performance of all skills compared to the 2010 group (16% vs 5%, aOR: 4.8 (95% CI: 1.2−19.2), *P*=0.03). There was no significant difference between the groups in time to EMS call, first chest compression and to shock delivery (Fig. 2B).

Discussion

We found that laypersons were better at following the BLS/AED algorithm three months after training when trained using the simplified 2015 guidelines compared to the 2010 guidelines without finding a significant difference immediately after training. Time to EMS call was shorter for the 2015 group immediately after training but no statistically significant differences were found for any of the other time outcomes.

Despite rapid deterioration of CPR skills in both groups, the 2015 group still demonstrated better retention in terms of adherence to the algorithm. These results support that even a small simplification in the BLS algorithm may facilitate better retention of resuscitation skills for laypersons possibly by making it easier to recall the acquired skills. Moreover, it may be more intuitive and less confusing to secure a diagnosis before shouting for help. Similar findings have been reported in a study showing that simplification of a BLS algorithm with use of compression-only CPR can improve retention of both CPR skills and adherence to the algorithm.[6] Several studies have also reported advantages in applying small simplifications to the CPR instructions.[16−19] Teaching chest compressions and ventilations using a staged approach (starting with each skill in isolation) has been shown to improve skill retention when compared to conventional training.[16] In addition, simplifying the teaching of correct hand placement for chest compressions with placement of the heel of the hand over the centre of the chest have shown to reduce chest compression pauses.[17] Moreover, chest compression depth improved in a study using the phrase "push as hard as you can" instead of "push down firmly 2 in. (5 cm)",[18] and similar simplifications of the

instructions for dispatcher-assisted CPR resulted in deeper chest compressions and better hand positioning.[19]

In contrast to the simplified 2015 guidelines, the changes from 2005 to 2010 guidelines included a more detailed instruction. This resulted in significantly fewer healthcare students passing a BLS course (2005: 89% vs. 2010: 84%, *P*<0.05).[20] Notably, their pass rates were higher compared to our study, most likely due to the study population being healthcare students. A study with laypersons reported similar BLS skill pass rates as seen in our study immediately after training (42%) and two months later (30%).[21]

We found no significant differences between groups in time to EMS call, first compression or shock except from a difference of five seconds in time to EMS call immediately after training. We believe that this small difference of five seconds in time to EMS call is unlikely to have a clinical effect on patient outcome. Importantly, studies have found that time to first compression and time to first shock have great impact on survival outcomes, but these time estimates did not differ between groups.[22−25]

The chance of survival is likely reliable on a multitude of contributing factors and the clinical impact of our findings is uncertain. However, it has been suggested that the greatest benefit in improving survival outcome may be achieved by focusing on improving early recognition of cardiac arrest and alerting the EMS in order for laypersons to carry out CPR afterwards.[26] Notably, our data suggest that more participants in the 2015 group remembered how to call the EMS three months after training when compared to the 2010 group. Moreover, it may be speculated whether the ability to follow the BLS/AED algorithm would also reflect self-confidence and willingness to act in a real cardiac arrest.

Limitations

This study evaluated the performance of laypersons in a simulated cardiac arrest setting. This is a post-hoc analysis of data from two randomised trials that were not powered for this analysis. We believed that confounding is limited as participants were recruited in a similar fashion with comparable inclusion and exclusion criteria. Participants' training background such as the number of training sessions and the time since last training were not available which precludes adjustment in the analysis. Moreover, the subjective nature of the assessments should be noted.[27,28]

Conclusion

Use of the simplified 2015 BLS guidelines was associated with better adherence to the sequence of the BLS/AED algorithm when compared to the 2010 BLS guidelines three months after training in a simulated cardiac arrest scenario, without significantly improving adherence immediately after training.

Author's contribution

Dung Thuy Nguyen: Methodology, investigation, formal analysis, project administration, writing − original draft, writing − review & editing.

Kasper Glerup Lauridsen: Conceptualisation, methodology, investigation, formal analysis, project administration, writing − original draft, writing − review & editing.

Kristian Krogh: Supervision, investigation, methodology, writing − review & editing.

Bo Løfgren: Conceptualisation, resources, methodology, investigation, supervision, project administration, writing − original draft, writing − review & editing.

Conflict of interest

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