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Simulation and education

e-Learning in Advanced Life Support—What factors influence assessment outcome?☆

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ABSTRACT

Aim: To establish variables which are associated with favourable Advanced Life Support (ALS) course assessment outcomes, maximising learning effect.

Method: Between 1 January 2013 and 30 June 2014, 8218 individuals participated in a Resuscitation Council (UK) e-learning Advanced Life Support (e-ALS) course. Participants completed 5–8 h of online e-learning prior to attending a one day face-to-face course. e-Learning access data were collected through the Learning Management System (LMS). All participants were assessed by a multiple choice questionnaire (MCQ) before and after the face-to-face aspect alongside a practical cardiac arrest simulation (CAS-Test). Participant demographics and assessment outcomes were analysed.

Results: The mean post e-learning MCQ score was 83.7 (SD 7.3) and the mean post-course MCQ score was 87.7 (SD 7.9). The first attempt CAS-Test pass rate was 84.6% and overall pass rate 96.6%. Participants with previous ALS experience, ILS experience, or who were a core member of the resuscitation team performed better in the post-course MCQ, CAS-Test and overall assessment. Median time spent on the e-learning was 5.2 h (IQR 3.7–7.1). There was a large range in the degree of access to e-learning content. Increased time spent accessing e-learning had no effect on the overall result (OR 0.98, P = 0.367) on simulated learning outcome.

Conclusion: Clinical experience through core membership of cardiac arrest teams and previous ILS or ALS training were independent predictors of performance on the ALS course whilst time spent accessing e-learning materials did not affect course outcomes. This supports the blended approach to e-ALS which allows participants to tailor their e-learning experience to their specific needs.

Introduction

The Formula for Survival[1] identifies three factors that influence survival from cardiac arrest: high-quality research, efficient education of patient caregivers and an effective chain of survival from the early recognition of cardiac arrest through to post resuscitation care.[2] Advanced Life Support (ALS) courses, which address both the second and third aspects of this formula, are used internationally to train healthcare personnel how to manage patients in cardiac arrest. Previous studies have linked participation on ALS courses to improved outcomes from cardiac arrest.[3–5] Courses use multimodal delivery methods to equip participants with background scientific knowledge, targeted clinical skills and non-technical skill development. This blended learning approach is from course manuals, online e-learning material, didactic lectures, hands-on skill stations and formative assessment. In the United Kingdom (UK) and many other countries, successful completion of an ALS course (or similar) is required for healthcare professionals who manage acutely unwell patients on a regular basis.

The Resuscitation Council (UK) has a 25 year history in delivering ALS courses.[6] A total of 20,268 individuals participated in an ALS course between January 2015 and December 2015.[6,7] In 2011,

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a strategic decision was taken to meet increasing demand, and to increase the flexibility of learning for participants. The Resuscitation Council (UK) launched a novel e-learning ALS course (e-ALS), as an alternative to the conventional two day face-to-face (c-ALS) course, valuing this key educational approach of blended learning. This constitutes 5–8 h of pre-course online e-learning, followed by a condensed, focussed one day face-to-face element. A multi-centre randomised control trial (RCT) in 2012[8] and a large observational study of 27,170 participants in 2015[9] demonstrated almost identical assessment outcomes for participants enrolled upon either c-ALS or e-ALS. The findings of these two studies consolidated the emerging role of the Resuscitation Council (UK) e-ALS course. Whilst outcome data were comparable in the observational study,[9] it did not assess the extent to which those participants enrolled on the e-ALS course actually accessed the e-learning material, or its effect on assessment outcomes.

Previous studies investigating the utility of e-learning all display a common limitation, whereby participants often do not fully access the e-learning material.[10,11] Jensen et al. investigated e-learning as a means for retaining ALS competency but found that only 57.5% of candidates accessed all of the stipulated modules.[10] Similarly Perkins et al. found that only 64% of candidates accessed pre-course e-learning via a CD prior to attending an ALS course.[11] This limitation was acknowledged by the authors, who postulated that any true difference between the control and intervention groups may not have been detected because the intervention had not been implemented effectively. Secondly, it provides challenges for ALS course organisers to establish exactly what extent of e-learning has been undertaken by the participants prior to attending a face-to-face course. Whilst this allows personalisation of the learning experience, it also reduces the standardisation of content delivered to those on an ALS course. Consequently, it is unknown whether making e-learning non-compulsory adversely affects candidate outcome.

This study was designed to access the aforementioned observational study data set,[9] analysing the extent to which participants access pre-requisite e-learning material, establishing the effect on candidate ALS assessment outcome. In doing this, study authors intend to highlight independent predictors of successful ALS course outcome.

Methods

Setting and participants

ALS participants voluntarily enrolled on a one-day e-ALS course at one of 94 national training centres. Each candidate registered on the Resuscitation Council (UK) Learning Management System (LMS) prior to attending the course. Participants were from a wide range of healthcare professions and stages of training.

The e-ALS course

The e-ALS course consists of 5–8 h of e-learning content covering essential ALS topics. Each candidate is given access to the LMS 8 weeks prior to their course and is asked to complete the 12 electronic learning modules. Additionally, participants receive a physical copy of the ALS course manual at least four weeks before the course date. e-Learning progress is monitored by the course centres. Participants are free to choose to personalise their learning experience—undertaking as little or as much of the e-learning preparation as they feel necessary although there are three compulsory modules: ALS in perspective; Advanced Life Support algorithm; non-technical skills (progress data are not routinely collected on the LMS for this module as it was only introduced in 2013).

There are nine non-compulsory modules: causes and prevention of cardiac arrest; acute coronary syndromes; monitoring, rhythm recognition and 12 lead ECG; bradycardia, pacing and drugs; tachycardia, cardioversion and drugs; special circumstances; post resuscitation care; arterial blood gas analysis; and decisions relating to resuscitation.

On completion of the e-learning, participants undertake a compulsory multiple choice questionnaire (MCQ), although their results in this do not affect the participants' post-course outcome. After completing the one-day face to face aspect, each candidate undertakes a post-course MCQ and a practical cardiac arrest management simulation test (CAS-Test). In order to achieve ALS competency participants need to pass both of these aspects. Participants are permitted two attempts at the MCQ and three attempts at the CAS-Test. The pre and post-course MCQs comprise 30 different stem questions, with each having four true/false answers, creating a total of 120 questions. The pass mark is 75%. The CAS-Test simulations are criterion based and are well validated.[12,13] They assess participants' abilities in patient assessment, formulating a treatment plan and leadership of the cardiac arrest team. Overall scores and pass/fail data are recorded.

Statistical analysis

Demographic data were collected on the LMS. Anonymised data were transferred to Microsoft Excel *(Microsoft Corporation, Redmond, USA)* and analysed using SPSS 23 *(IBM, Armonk, USA)* and R statistical program Version 3.3.1.[14] Categorical baseline characteristics were summarised using counts and percentages while continuous baseline characteristics were summarised using mean, median (IQR, interquartile range) and ranges. Independent *t*-tests, one-way ANOVAs and linear regression models were utilised to determine differences between continuous variables. Logistic regression was used for dichotomous outcome variables.

A multivariable logistic regression model was fitted to assess which variables predict whether a trainee passes the CAS-Test on the first attempt. Trainees attending the same course session tend to have similar outcomes[8] and so the multivariable logistic regression model included a random effects term for course session. A similar model was fitted to assess which variables predict whether a trainee passes the overall test. Odds ratios (OR), 95% confidence intervals and p-values from the multivariable random effects logistic regression models were reported. To assess which variables predict the MCQ score of a trainee in the first attempt, MCQ scores were analysed by fitting a linear mixed model with a random effects term for course session. Mean difference in MCQ scores, 95% confidence intervals and p-values from the linear missed model were reported. An analysis of standard residuals was carried out and outliers removed. Co-linearity was assessed by independently entering each independent variable into a logistic regression with the remaining variables entered as dependent variables. Collinearity diagnostics were calculated and the variance inflation factor (VIF) in all instances was <1. In all models, missing data were excluded from the complete case analysis by a listwise deletion. Statistical significance was set at P-values of <0.05.

Results

Demographics

8218 participants were enrolled on one of 450 e-ALS courses during the study period. Mean age was 32.0 years (SD 8.2). 15 participants started but failed to complete the course. 1.8% of the total

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