Reviewer’s report

Title: Implementing Blended Learning in Emergency Airway Management Training: A Randomized Controlled Trial

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Reviewer: Joshua Nagler

Reviewer’s report:

This is a thoughtful description of the development and assessment of a novel educational approach to airway management instruction. The authors use a randomized controlled trial design to compare blended/distance learning with face to face instruction. Junior doctors completed either distance learning or an in-person workshop, followed by hands on training with simulators. The authors were able to demonstrate equivalence between the two modes of content delivery using a knowledge based assessment as the primary outcome. They identified positive perceptions of the blended learning curriculum as a secondary outcome, using descriptive and qualitative analyses. In addition, measurement of comfort with information and communication technology was assessed as a potential confounder of the observed results. The authors conclude that blended learner is as effective as in person instruction, is well received, and may offer some advantages over in person instruction.

The topic is important, the randomized methodology is rigorous, and the manuscript is well written. The authors' conclusions are well matched to the reported findings. The availability of the materials online allows for anywhere, anytime, learning, which might also be used for just-in-time type learning.

There are a few areas that could be addressed to strengthen the paper.

1. Equivalence of the two arms.
   * The authors note that the BL course contents were with those delivered in the f2fL arm. What was the actual content - was it related to indications for airway intervention, procedural technique, pharmacology for airway management, etc.?
   * The authors estimate the online sessions would take approximately 40 minutes per day. Where did this estimate come from? Was timing performed during the vetting and revision of the materials to assess the accuracy of this estimate?
   * The BL online materials were noted to include videos, manuals, and quizzes. In the discussion section, this is further identified as "online quizzes and activities such as crossword puzzles and 'fill in the blanks' with instant feedback in the form of answers." Did the presentation of the material in the f2f arm use similar techniques in the classroom? If not, is it possible that the online learning was improved because of engaging pedagogic strategies not available to those
in the f2f workshop, and had similar approached been used in person that learning might have been enhanced. As the learners identify, these engaging strategies were "to help solidify the lessons learnt." Were the f2f participants offered the same learning strategies? Was there additional benefit of BL related to spaced learning, gamification, use of videos and dual channel learning, etc. that might also have been used with f2f?

* Similarly, the authors note that social networking was promoted in the BL arm, and in the results (line 220-227) suggest that this may have been beneficial for many learners. Were there equivalent efforts to promote discussion and sharing of ideas during the f2f workshop? The aim would be to have the two arms have equivalent active participation by learners in the two arms.

* Was there standardization of the teaching/experience during the simulated hands on component of the course for the two groups?

2. Primary outcomes

* What was the actual content of the questions used to assess the impact of the educational interventions? Table 2 and 3 identify specific items for the ICT etc, but it is not apparent what questions were asked to assess the participants' improvement in knowledge. Table 5 breaks up the scores into theory and practical, but without identification of actual content. Some information emerges from the open ended questions (lines 283-285), but specific assessment items are not offered. Perhaps an additional table or an appendix would be valuable.

3. Secondary outcomes

* The authors provide a great deal of information regarding the secondary outcomes in the results section. It would be helpful to include a descriptive plan for these analyses in the methods section.

4. Alternative outcomes

* The measured outcomes are participant reactions to the instruction and change in knowledge. While these are helpful, they are considered lower level outcomes using Kirkpatrick's training evaluation model. Particularly for a procedural skill like advanced airway management, demonstration of improved procedural performance would be particularly valuable. Given all participants were onsite using simulators for one day, were there any attempts to assess behaviors/skills rather than just knowledge?

5. Means of validation

* The authors report validation of skills stations (line 140), course objectives (line 149), and questionnaire items (line 155) were all validated. What was the methodology for validation
of these materials? Content validity by expert consensus? Was a Delphi technique used? How were differences of opinion resolved?

6. Patient flow

* How was the sample size calculated? The authors note it was based on a prior study, but were the expected differences between the two groups in this study expected to be the same as in the Lancaster study? How were expected differences here estimated?

* Did any participants drop out of the study? If so, were these rates equal between the two groups? A flow diagram might be helpful.

7. Discussion section

* The authors provide a well written, thoughtful review of theories and framework in the discussion section. There is little reference to findings from prior work. It would be valuable to include references addressing the use of BL in other disciplines and/or alternative strategies for teaching airway management and how this study adds to that prior work.

Are the methods appropriate and well described?
If not, please specify what is required in your comments to the authors.

Yes

Does the work include the necessary controls?
If not, please specify which controls are required in your comments to the authors.

Yes

Are the conclusions drawn adequately supported by the data shown?
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