

## PEER REVIEW HISTORY

BMJ Open publishes all reviews undertaken for accepted manuscripts. Reviewers are asked to complete a checklist review form (<http://bmjopen.bmj.com/site/about/resources/checklist.pdf>) and are provided with free text boxes to elaborate on their assessment. These free text comments are reproduced below.

### ARTICLE DETAILS

<b>TITLE (PROVISIONAL)</b>	Does the age of acute care physician's impact their 1) crisis management performance and 2) learning after simulation-based education? A protocol for a multicentre prospective cohort study in Toronto and Ottawa, Canada.
<b>AUTHORS</b>	Alam, Fahad; LeBlanc, Vicki; Baxter, Alan; Tarshis, Jordan; Piquette, Dominique; Gu, Yuqi; Filipkowska, Caroline; Krywenky, Ashley; Kester, Nicole; Cardinal, Pierre; Au, Shelly; Lam, Sandy; Boet, Sylvain; Perioperative Anesthesia Clinical Trials Group, Perioperative Anesthesia Clinical Trials

### VERSION 1 – REVIEW

<b>REVIEWER</b>	Thelma Quince Primary Care Unit Department of Primary Care University of Cambridge UK
<b>REVIEW RETURNED</b>	22-Dec-2017

<b>GENERAL COMMENTS</b>	<p>This proposed study addresses an important issue. In the main the protocol clearly describes the proposed study. As the paper currently stands, however, the abstract does not entirely conform to the requirements set out by BMJ Open i.e. no mention of ethical approval and dissemination, nor is there any section outlining the strengths and limitations of the study. Although ethical approval and dissemination are discussed in the main text, the strengths and limitations of the study are not.</p> <p>Some of the language is a little verbose and I have made minor and discretionary suggestions as track changes on the attached document "Impact of age".</p> <p>- The reviewer also provided a marked copy with additional comments. Please contact the publisher for full details.</p>
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<b>REVIEWER</b>	Matt Beal Poole Hospital NHS Foundation Trust Longfleet Road Poole Dorset United Kingdom
<b>REVIEW RETURNED</b>	24-Dec-2017

<b>GENERAL COMMENTS</b>	The manuscript describes a research protocol for a prospective cohort study which examines the influence of acute care physician age on baseline crisis resource management (CRM) skills and on
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the effectiveness of high fidelity simulation for teaching CRM skills.

There is a growing evidence base for the use of simulation based teaching, particularly within trainee and undergraduate groups, which has led to significant investment in equipment, facilities and faculty time. Although simulation does seem to be effective as a teaching method on the whole, it is becoming increasingly clear that this is not always the case. The proposed study is a welcome attempt to investigate how physician age may play a role on influencing the effectiveness of simulation based teaching.

Methodologically, the manuscript describes a pragmatic approach to investigating the relationship between physician age and efficacy of simulation based teaching. The research question is focussed and clinically logical. The authors describe a sensible method to simulation scenario development and the protocol follows a well-established pattern for assessing short and long term effectiveness of simulation based teaching. The outcome and performance measures are commonly used and validated in this type of research which will make the findings easily interpretable and relevant within the scope of the existing evidence base.

The authors may like to consider the following points:

Abstract:

1) Page 3 L14: apostrophe should be physician's  
Introduction:

2) Page 5 L8: Suggest grouping together the statistics for the proportion of physicians over the age of 55 for readability.  
"Approximately 32-40% of anaesthesiologists, emergency and critical care physicians are over the age of 55.

3) Page 5 L17: The following explanation for increasing workforce age is somewhat verbose and I think could be worded better to form a stepwise conclusion. I would suggest rewording this – perhaps "The shift in workforce demographics may be explained by several factors such as the recent economic crisis, which has forced some physicians to choose to delay retirement. Furthermore, the reduction in the number of residency positions in the early 1990s led to a smaller proportion of middle aged ACPs. With an overall shortage of healthcare providers, this has led to a greater proportion of older ACPs delaying retirement in order to meet the demands of the healthcare system."

4) Page 5 L51: to "a" great extent

5) Page 5 L54: as one "ages".

6) Page 6 L3: apostrophe should be anaesthesiologist's

7) Page 7 L20: I'm not sure that the referenced paper (Curtis MT, 2012) supports your statement that there is limited evidence that simulation actually improves learning. There is a lot of evidence from reasonably recent meta-analyses that simulation improves learning, but there is quite a degree of between study variation in effect size which suggests that simulation is not always effective. It is also true to say the quality of primary studies are generally of a weak grade on quality assessment. The two meta-analyses that look

	<p>at the effectiveness of simulation referenced in the Curtis paper are now reasonably outdated as well.</p> <p>Methods and Analysis</p> <p>8) Page 8, Line 10: suggest specifically state “whether ageing influences the effectiveness of CRM...”</p> <p>9) Page 8 Line 42: comma after large not needed</p> <p>10) Participant selection – it is not clear exactly how prospective participants are to be identified and approached for recruitment. Defining whether they intend to invite “all potentially eligible physicians” or how they intend to produce a sample of physicians is important to minimise selection bias.</p> <p>11) The approach to simulation scenario development seems appropriate in the context of the research question – if this development has already taken place the authors may like to consider expanding on the content of the scenarios.</p> <p>12) The authors state that the orientation scenario is for familiarisation with the simulation environment – they may like to consider what is the optimal amount of time for participants to spend familiarising themselves with the environment. They should specifically state whether the later intervention scenarios will be in the same environment with the same equipment as the orientation scenario.</p> <p>13) Tailoring simulation environment to the participant’s respective speciality is a good strategy for reducing the extraneous cognitive load involved in simulation. The manuscript describes learning from “high fidelity simulation” which is a term commonly used to describe the use of a particular style of mannequin technology in simulation teaching. Whilst this is reasonably common practice, fidelity (or level of simulated realism) is a more complex concept than just the type of equipment used. I would suggest that it would be good practice to expand further on the environmental and psychological, as well as technological fidelity of their proposed simulation interventions.</p> <p>14) The authors state that the first PEA-arrest scenario will be led by a 20 minute facilitator-led debrief on their CRM performance. As this is arguably the point where the most learning will take place, the protocol would benefit from expansion of how the debrief will be facilitated. i.e. whether it will be structured, address pre-defined learning outcomes or whether they intend to use any standardised tools to facilitate the debrief.</p> <p>In conclusion, I feel the submitted manuscript is interesting, well written and with a few minor adjustments is suitable for publication. Thank you for the opportunity to review your work - I hope the discussion points for consideration above provide some useful areas to think about.</p>
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<b>REVIEWER</b>	Rune Jakobsen University of Oslo and Akershus University Hospital, Norway
<b>REVIEW RETURNED</b>	03-Jan-2018

<b>GENERAL COMMENTS</b>	There seems to be two versions with small differences of the
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	<p>manuscript included in the PDF - I have based the following on the first version and considered the last version to be the study protocol just appended for comparison.</p> <p>This is an interesting study. The research questions are clearly presented and methods seems appropriately chosen. The authors discuss limitations thoroughly, however I share their concern of recruitment bias. One might consider monitoring how many doctors participating of the total available at the respective centers and also include on the questionnaire why the chose to volunteer/participate. Statistical methods and considerations also seems appropriately chosen and discussed.</p> <p>The actual scenarios are not described in detail but the authors state how these are to be developed. Ideally the development and testing of these had been finished and included in the protocol. The authors state that the reviewers of the videotaped simulations will be blinded to the hypotheses of the study, this is naturally a good intent however I am uncertain whether this is practically achievable.</p>
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### VERSION 1 – AUTHOR RESPONSE

Editors comments:

1. Please revise your title to state the research question, study design, and setting (location). This is the preferred format for the journal.

The title has been changed to match requirements.

2. We feel that your study is best described as prospective cohort study, as opposed to a prospective cohort trial. Please amend the language used in the manuscript accordingly.

Changes have been made to reflect that this is a prospective cohort study throughout the paper.

The original protocol for the study, where one exists, as a supplementary file

Reviewer 1:

1. This proposed study addresses an important issue. In the main the protocol clearly describes the proposed study. As the paper currently stands, however, the abstract does not entirely conform to the requirements set out by BMJ Open i.e. no mention of ethical approval and dissemination, nor is there any section outlining the strengths and limitations of the study. Although ethical approval and dissemination are discussed in the main text, the strengths and limitations of the study are not. The full submission included both the updated manuscript to be considered for publication (pages 1-23 of the pdf) and a copy of the original abbreviated protocol (pages 24-32) for comparison. Reviewer 1 has kindly reviewed and made edits/comments to the abbreviated original protocol (attached as a supplementary) and not the actual manuscript that was submitted for publication. As such, included in the full manuscript was an abstract that conforms to the requirements including outlining ethics approval and mention of the limitations and strengths. As the abbreviated protocol was not necessary for the submission of study protocols to BMJ Open, we have deleted this document from this revised submission.

2. Some of the language is a little verbose and I have made minor and discretionary suggestions as track changes on the attached document "Impact of age". We agree about the verbosity of language in the abbreviated protocol and as such, in the submitted manuscript – the background was edited to make it more condense and to the point. We have also

looked over the reviewer edits made on the abbreviated protocol and, any not addressed by the full manuscript, we updated.

Reviewer 2:

1. Page 3 L14: apostrophe should be physician's

This is now changed in the manuscript.

2. Page 5 L8: Suggest grouping together the statistics for the proportion of physicians over the age of 55 for readability. "Approximately 32-40% of anaesthesiologists, emergency and critical care physicians are over the age of 55.

This is now changed in the manuscript.

3. Page 5 L17: The following explanation for increasing workforce age is somewhat verbose and I think could be worded better to form a stepwise conclusion. I would suggest rewording this – perhaps "The shift in workforce demographics may be explained by several factors such as the recent economic crisis, which has forced some physicians to choose to delay retirement. Furthermore, the reduction in the number of residency positions in the early 1990s led to a smaller proportion of middle aged ACPs. With an overall shortage of healthcare providers, this has led to a greater proportion of older ACPs delaying retirement in order to meet the demands of the healthcare system."

This is now changed in the manuscript ensure readability.

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This is now changed in the manuscript.

7. Page 7 L20: I'm not sure that the referenced paper (Curtis MT, 2012) supports your statement that there is limited evidence that simulation actually improves learning. There is a lot of evidence from reasonably recent meta-analyses that simulation improves learning, but there is quite a degree of between study variation in effect size which suggests that simulation is not always effective. It is also true to say the quality of primary studies are generally of a weak grade on quality assessment. The two meta-analyses that look at the effectiveness of simulation referenced in the Curtis paper are now reasonably outdated as well.

We agree with the reviewer's comments that simulation has been shown to improve learning but we are attempting to highlight that the majority of this literature and reviews have been in the junior learner population. As such the reference for this statement in the manuscript is for an updated systematic review done by Khanduja et al in 2015 specifically looking at the continuing medical education population.

8. Page 8, Line 10: suggest specifically state "whether ageing influences the effectiveness of CRM..."

This is now changed in the manuscript to "whether ageing impacts CRM...."

9. Page 8 Line 42: comma after large not needed

This is now changed in the manuscript.

10. Participant selection – it is not clear exactly how prospective participants are to be identified and approached for recruitment. Defining whether they intend to invite “all potentially eligible physicians” or how they intend to produce a sample of physicians is important to minimise selection bias. This has been updated in the “participant characteristics” section

11. The approach to simulation scenario development seems appropriate in the context of the research question – if this development has already taken place the authors may like to consider expanding on the content of the scenarios. This is currently being done and will be included in the final manuscript after they study is complete.

12. The authors state that the orientation scenario is for familiarisation with the simulation environment – they may like to consider what is the optimal amount of time for participants to spend familiarising themselves with the environment. They should specifically state whether the later intervention scenarios will be in the same environment with the same equipment as the orientation scenario. These suggestions have been updated in the manuscript.

13. Tailoring simulation environment to the participant's respective specialty is a good strategy for reducing the extraneous cognitive load involved in simulation. The manuscript describes learning from “high fidelity simulation” which is a term commonly used to describe the use of a particular style of mannequin technology in simulation teaching. Whilst this is reasonably common practice, fidelity (or level of simulated realism) is a more complex concept than just the type of equipment used. I would suggest that it would be good practice to expand further on the environmental and psychological, as well as technological fidelity of their proposed simulation interventions.

We have added the following explanatory sentences in the section of “Simulation Scenario Development”:

The core concepts pertaining to CRM skills and subsequent management of pulseless electrical activity (PEA) arrest will be consolidated into one document by the principal investigators (FA and SB) and then sent out to three faculty acute care physicians (one from each specialty involved) from Universities not involved in the recruitment, who are trained advanced cardiovascular life support (ACLS) instructors, for review and revisions. Once core concepts are agreed upon, the three simulation scenarios will be developed. The simulation environment for each scenario will be tailored to their respective specialty (i.e. Intensive Care Unit, Operating Room, and Emergency Room). Each scenario will be adapted in terms of environment (layout/equipment) and appropriate background noise (overhead announcements, monitor noise) for the participant's specialty to ensure psychological and environmental/technical fidelity. Each scenario will then be piloted before recruitment to ensure an equal degree of difficulty and appropriate fidelity.

14. The authors state that the first PEA-arrest scenario will be led by a 20 minute facilitator-led debrief on their CRM performance. As this is arguably the point where the most learning will take place, the protocol would benefit from expansion of how the debrief will be facilitated. i.e. whether it will be structured, address pre-defined learning outcomes or whether they intend to use any standardised tools to facilitate the debrief.

A separate heading has been included called “Debrief” with the following paragraph:

“All facilitators will be experienced in debrief and CRM training. Despite this, the facilitators will be trained on the outcome measures and will have the opportunity to debrief the participants in the pilot scenarios prior to the recruitment of study participants. Debrief will be led using the standardised ACLS algorithms and non-technical skills measured by the outcome assessment tools.”

Reviewer 3:

1. There seems to be two versions with small differences of the manuscript included in the PDF - I have based the following on the first version and considered the last version to be the study protocol just appended for comparison.

This is an interesting study. The research questions are clearly presented and methods seems appropriately chosen. The authors discuss limitations thoroughly, however I share their concern of recruitment bias. One might consider monitoring how many doctors participating of the total available at the respective centers and also include on the questionnaire why the chose to volunteer/participate. Thank you for your recommendation. The full submission included both the updated manuscript to be considered for publication (pages 1-23 of the pdf) and a copy of the original abbreviated protocol (pages 24-32) for comparison. As the abbreviated protocol was not necessary for the submission of study protocols to BMJ Open, we have deleted the document from this revised submission. At the end of recruitment we will definitely take note of participants' demographics and recruitment characteristics.

2. Statistical methods and considerations also seems appropriately chosen and discussed. The actual scenarios are not described in detail but the authors state how these are to be developed. Ideally the development and testing of these had been finished and included in the protocol. Thank you for the suggestion – we are currently in the process of testing the scenarios and will be included in the final manuscript once recruitment is completed.

3. The authors state that the reviewers of the videotaped simulations will be blinded to the hypotheses of the study, this is naturally a good intent however I am uncertain whether this is practically achievable.

We will ask the reviewers and ensure that they have not heard about the study nor participated in it. The reviewers will only have access to the ACLS checklist, Ottawa GRS, and the videos. They will not be provided with participant demographics.

**VERSION 2 – REVIEW**

<b>REVIEWER</b>	Matt Beal Poole Hospital NHS
<b>REVIEW RETURNED</b>	25-Mar-2018

<b>GENERAL COMMENTS</b>	<p>Thank you very much for your revision, which has greatly improved the manuscript.</p> <p>The revised manuscript describes a research protocol for a prospective cohort study which examines the influence of acute care physician age on baseline crisis resource management (CRM) skills and on the effectiveness of high fidelity simulation for teaching CRM skills. I again congratulate the authors for their attempts to investigate this important issue and their protocol remains thorough and rigorous and will no doubt yield important results. The authors have made a good effort to address the critique and comments of the reviewers and I appreciate the effort that has gone into revising the manuscript. With regards to my original critique, the vast majority of the questions have been addressed to my satisfaction.</p> <p>There are a few very minor issues which may be appropriate to just address at the proofing stage, and the authors are already aware of the more major issue (point 3) below and have discussed it adequately in the manuscript in my opinion.</p> <p>1) Page 2 Line 2 - The changes to the title mean the apostrophe in physician's is incorrect again – you could probably do without it entirely, if not it should now be physicians' as in the original</p>
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	<p>manuscript.</p> <p>2) The Keywords probably shouldn't contain Randomised Control Trial as the manuscript describes a prospective cohort study.</p> <p>3) Page 10 Line 8 – Thank you for clarifying the methods for recruitment. As discussed later in the manuscript, there is a concern that participants will essentially be self-selecting with the recruitment method described and there is therefore a reasonable risk of recruitment bias. I do however understand the practical reasons for doing this, and similar methods are not uncommonly seen in the existing literature.</p> <p>In practice when actually conducting the study, the authors should carefully monitor how their sample relates to the overall population that they are aiming to study, in order for their results to be generalizable to the population as a whole. Ideally, I would aim to identify some good descriptive data on the population to be studied, so that the sample can be properly compared. Additionally, monitoring this from the beginning will give you the opportunity to justifiably deviate from the protocol to widen recruitment in order to ensure that the sample is representative, if the need arises.</p>
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