Author’s response to reviews

Title: Assessing anesthesiology residents' out-of-the-operating-room (OOOR) emergent airway management

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Dr. Guangde Tu
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Re: BANE-D-17-00039
Assessing anesthesiology residents' out-of-the-operating-room (OOOR) emergent airway management Lauryn Rochlen; Michelle Housey; Ian Gannon; Shannon Mitchell; Deborah M Rooney; Alan R Tait; Milo Engoren BMC Anesthesiology

Dear Dr. Tu,
Thank you very much for the helpful comments and suggestions provided by yourself and the reviewers. We greatly appreciate the opportunity to make this manuscript stronger and as one of your reviewers suggests, help our experience serve as a wake-up call to fellow training programs. Below you will find the responses to your helpful suggestions. Changes to the manuscript are highlighted in the revised document.
On behalf of my co-authors, again, thank you for this opportunity and we look forward to hearing back from you.
Lauryn R. Rochlen

Ruediger Noppens, MD, PhD (Reviewer 1): This is an interesting manuscript! Thank you very much for doing this important study! For me, it underlines that residents are not qualified for ODOR airway management and clinical teaching as well as training are still insufficient.

1.) Out-of-the-OR airway management has been found to be the most challenging field in medicine. The incidence of difficult intubations are much higher than in the OR, why should a resident perform airway management in the most difficult setting? It seems that this would require the best-trained anesthesiologist with as much experience as possible to act in this kind of environment. It would be great if the authors could address this issue in the manuscript.

The authors agree that with a higher incidence of complications, OOOR airway management should be in the hands of experienced providers. There however continue to be institutions, such as ours, where resources are not always available for this to occur. We have added more to the discussion on this topic to highlight this point. Page 15

2.) Comparing "junior" vs. "senior" residents has a limitation. It does not measure the actual experience in difficult airway management or experience in ODOR airway management. Please address this in the manuscript.

Based on our policies, only senior residents are permitted to manage OOOR airways and are thus expected to have more experience than junior residents. However, the actual experience of the residents is not known. We have added as a limitation that we did not classify residents by their individual experience with OOORAM, but rather used the arbitrary classification of junior and senior residents based on the policies in place at our institution. Page 18.

3.) It seems to me that most residents studied the ASA algorithm and therefore felt confident to use this approach. However, the present data put the ASA algorithm in question because the
residents had trouble following this method. Maybe a different, more simplified algorithm is needed? Please include this in the discussion of the manuscript.

This is definitely an interesting point. We elected to study the basic structure of the ASA Algorithm, but there certainly are alternative algorithms available that may be more appropriate for this setting. Page 17. However, future studies will need to compare these different algorithms in both simulations and, then, in clinical practice.

4.) Another limitation of a study like this are the clinical teachers of residents! If daily clinical teaching is not addressing multiple aspects of airway management simulation alone can not make up for it. Please discuss this aspect in the discussion section.

We agree that this is a limitation and have added it to the Discussion. The paragraph in the discussion beginning on Page 16 suggests that a more formal curriculum in airway management could be beneficial and would include multiple modalities of teaching.

5.) Is it a bad thing not to follow precisely an algorithm? I guess it is the outcome that matters. What is wrong with a different approach if oxygenation can be achieved in a crisis without following every single step of an algorithm? Please address this issue in the manuscript.

It is certainly not a bad thing to not follow an algorithm. However, an algorithm may be beneficial for appropriate planning and preparation in case of difficulty. This notion has been added to the Discussion on Page 15.

Anthony Kovac (Reviewer 2):
page 9 line 190: Please describe the checklist of tasks.

The full checklist is available as Appendix C. A brief summary of the task categories has been added to the Methods section on Page 9.

page 10, line 221: Why 2 and not 3 groups, one for each CA year, 1,2,3?
We chose to group them into 2 groups based on the policy at our institution only CA3 residents are allowed to intubate during OOOR events. This has now been addressed as a limitation in the Discussion section.

page 11, line 240: Residents in what years?

This section refers to all residents. If you feel this needs further clarification we can certainly include that.

page 11, lines 245-246: was the simulation mannequin that of a normal or difficult airway? what brand type of airway mannequin? Laerdal?

The type and brand of mannequin are described in the Methods section on Page 9. We have added at the difficult airway settings were in place to challenge the residents. This update can also be found on Page 9.

page 12, line 12: Why did the residents not consult staff more often? 32% seems low.
At my institution, the staff during the day and staff on call always attend all out intubations, in and outside the OR.

As noted in the background and discussion, there are academic institutions where residents are permitted to perform OOOR intubations without faculty presence. This includes our institution, and it is therefore not so surprising that the majority of residents did not request faculty presence.

page 13, lines 278-282: What was the total number of intubations achieved by each group of residents?

Each resident only went through the simulation once, with one possible intubation. We have added this to the Methods section.

page 13, table: why were the junior residents not split into CA1 and CA 2 years?
This has been updated in the Methods section and added as a limitation in the Discussion.

page 14, table: In first glidescope attemptection, do the residents know how to evaluate for a difficult airway?

During the simulation scenario residents needed to request that a GlideScope be brought into the room. It was not immediately available or brought in with the standard airway management equipment. This has been clarified in the Methods section on Page 9.

page 15, line 312: Please add the words, "in our institution." At other institutions, teh results may be different. Not all training programs are the same.

This has been updated accordingly.

page 17 line 351: I think that discussion of medical legal issues should be discussed if staff are not present. Staff are present at my institution for this reason.

We have added language in the Background and Discussion sections to emphasize that this it is not the case at all institutions where residents are permitted to act independently. At our institution it is permissible for residents to act independently. While it is a great idea to discuss the medical legal issues, it is beyond the scope of this paper, and certainly beyond the legal expertise of our authors. Additionally, the legal implications may vary by state and country.

page 17, line 371-372: What was the associated time limit?

The time limit of the scenario was 5 minutes and 15 seconds. The progression of the scenario is available in Appendix 2.

Kurt Ruetzler (Reviewer 3): Thanks very much for giving me the opportunity to review this nice written and interesting manuscript. I do have some minor questions/ suggestions:
1. line 115-116: I am also working in a major academic hospital in the US and residents are NEVER allowed to intubate a patient without direct supervision by a staff. For my impression, this sentence is too strong and is not adequate as a general statement.

Thank you for highlighting this critical point. The wording has been modified as suggested on Page 6.

2. line 198: when was the post-simulation survey performed? It might be interesting, if the post-simulation survey differs, if performed after the simulation, but before and after the performance feedback by the researcher?

The post-simulation survey was completed immediately following the completion of the simulation. This was added to the post-simulation section in the Methods on Page 10 to clarify.

3. line 355/ table 1: Interestingly, senior residents were more likely to do not attempt bag-mask ventilation the patient? How did these residents call for a cannot ventilate/ cannot intubate situation?

In Table 1 it shows that statistically speaking both groups of residents were just as likely to omit the bag-mask ventilation task, which underscores their possible lack of understanding and preparation. This pattern could be due to 3 possibilities: 1) they were successful with intubation and did not need to attempt bag-mask ventilation, 2) they incorrectly skipped this step or 3) they ran out of time and the scenario ended. Not attempting bag-mask ventilation in the setting of an unsuccessful intubation would constitute a failure to follow the ASA algorithm and that resident would have been analyzed as such.

4. once the residents received the email invitation, the residents were aware of the goals of the study. It might be possible, that residents with less familiarity with airway management did not voluntarily participate in this study (as only 63 out of 90 residents participated!!?). I actually think, that this is a classic example of inclusion bias? Please add this as a limitation.
All residents were invited to complete the pre-simulation survey. Selection to complete the simulation component was based on resident availability on the scheduled testing days. Therefore, some residents who completed the pre-simulation survey did not complete the simulation. Only residents who had a complete set of data were included for analysis. This has been updated in the Results section on Page 11. We have added this as a limitation to the Discussion to show inclusion (or exclusion) bias.

5. another limitation might be, that residents were potentially talking with residents and communicated essentials of the simulation scenario. Did you advice the residents, to do not share their experience with other residents (although you might not avoid it)? Again, please add this as a limitation.

This has been added as a limitation of the study in the Discussion section on Page 18.

6. Did any resident request any medication at all? It is for example well known, that neuromuscular blocking agents ease endotracheal intubation. I hope that I understood the simulation scenario correctly... the patient experienced desaturation, but was still spontaneously breathing and more or less awake?

As outlined in Appendix 2, the patient becomes unresponsive during the scenario due to hypoxia. The Methods section has been updated to state that residents were required to request medication from the nurse confederate if they wished to provide medication to the patient. (Page 9) Preparation of medications is also one of the tasks included on the checklist under the equipment preparation category.

7. The C-spine was not cleared at the time of intubation. Was the c-spine immobilized? If yes, how and/or which device? If not, did you investigate (but not report) c-spine movements?

We have added that a hard cervical collar was in place on the mannequin and that all difficult airway settings were turned on to enhance the fidelity of the scenario. Page 9.
8. I fully agree, that airway competence is one of the most important competences of anesthesiology providers. Did any one of the residents have any previous experience with simulation of a difficult airway? In many institutions, airway management and simulated difficult intubation is more or less intensively taught during the first clinical year. The airway management course is on a voluntary base at your institution. How many residents participated in this course before this simulation scenario?

This is a very relevant question and we have updated the Results section accordingly on Page 12. We did ask the residents if they had attended the Difficult Airway Course on the pre-survey. We then looked to see if whether they had attended the course correlated with them following the algorithm. Interestingly, it did not. This suggests even more that a focused curriculum on OOOR issues is needed, not just a focus on difficult airway management. We have added this to the Discussion as well as on Page 17.