Reviewer's report

Title: Physiology of residents in simulation medicine: the PRISM study

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Reviewer: Daniel Girzadas Jr.

Reviewer's report:

Overall very nice effort to capture stress, heart rate, & clinical performance data of residents participating in a typical simulation environment used by many residency programs. This information is important to know for faculty members across all specialties. I think with revisions, the paper will be an excellent addition to the literature on this topic.

1. Is the question posed by the authors well defined?

Yes. I think the concept of asking what is the degree of stress associated with being tested in a simulated environment is important. Then whether self-reported cognitive stress correlates with heart rate is important. Then asking if heart rate correlates with a validated CRM measurement is a logical next step. I also think using a validated measure of CRM as your assessment of clinical performance is clever and scientifically strong. Asking whether PGY status affects perceived stress and heart rate is important as well.

Discretionary Revisions: none

Minor Essential Revisions: none

Major Compulsory Revisions: The Flow Score is not discussed at all in the background section, last paragraph, where the research questions is described. Only the Ottowa GRS is listed. Yet the Flow Score is discussed at length and appears to be a key measurement in the methods and results sections. I would say there should be some comment/discussion/listing of the Flow Score as part of the research question. Why is the Flow Score being used? Is it also validated? If not, the Ottowa CRM seems to be a better outcome measurement.

2. Are the methods appropriate and well described? Strong aspects of the methods: Well developed simulation cases, validated Ottowa GRS, it seems that multiple faculty evaluated each resident’s performance, holter monitor is an excellent way to measure heart rate, good measurement of baseline heart rate.

Discretionary Revisions: A statement of what the stakes for the residents were in this simulation would be useful. In the manuscript it was stated that this annual simulation was used as part of the promotion process. Is this a high stakes assessment where failure bars advancement or more likely is this is more of a formative evaluation that gives the resident feedback for areas to work on? If it is a high stakes test, the stakes may be the cause of increased stress/heart rate rather than the simulation itself.

Minor Essential Revisions: none
Major Compulsory Revisions: More thorough description of the Flow Score. I am assuming it is a percentage of the number of critical actions completed on the scenario forms listed in the supplementary files. If that is the case this should be stated more explicitly. The number of evaluators per each resident should be stated more clearly. In Methods paragraph 2, line 7 and 8 you state, “A group of 3-5 faculty raters assess...” Does this mean 3-5 raters per resident or 3-5 raters assessed each PGY level and each resident within that group had one faculty assessment? They way evaluators worked together should also be described. Did evaluators independently rate each resident or was discussion regarding scoring between evaluators allowed? Inter-rater reliability samples should be calculated unless your truncation method of the evaluations somehow precludes this. I am not facile enough with statistics to know whether this is so.

3. Are the data sound? The fact that the investigators got a baseline resting heart rate for all participants at a non-simulation event is methodologically strong. If multiple evaluators were used for each resident that is also a strength. Holter monitoring is an excellent method to gather heart rate data. I think the process described of using simulation scenarios to evaluate their residents is a valid real-world practice that many residencies use.

Discretionary Revisions: Did faculty evaluators have any training in CRM evaluation? Was there any effort made prior to the simulations to educate evaluators regarding the assessment tools? Were videos taken of the testing for review by other evaluators?

Minor Essential Revisions: none

Major Compulsory Revisions: It should be stated whether/how much/at what training level resident participants in the study received any prior CRM training and how familiar they were with the CRM scoring instrument. For example, Did EM3’s go through a CRM course at some point in training/previous simulations that EM1’s had not yet gone through? This would affect the validity of the CRM measurement.

How well did faculty evaluators in the study know the residents? Were evaluators blinded to PGY level? More probably they knew each resident’s PGY level and may have had some bias based on previous clinical contact. Were there any evaluators from outside the program who did not know the residents’ PGY level? I think some further description of the evaluators and their relationship to the residents would strengthen the manuscript. Again, I think some inter-rater reliability data would give confidence to the assessment results. Was there any relationship between caffeine use and anxiety/heart rate? You captured this data but I could not find it reported in your results. Caffeine could have affected the heart rate and anxiety data.

4. Does the manuscript adhere to the relevant standards for reporting and data deposition?

Discretionary Revisions: none

Minor Essential Revisions: The results section does not address with verbage the secondary outcome stated in the background section of whether HR correlates
with CRM ability. This is what I would want to know the most actually. The scatter plots in figure 2 seem to say no but it took me awhile to figure it out. It should be stated explicitly in the results section. The correlation between stress/heart rate and PGY status was listed as a study question in both the background and discussion sections. The data is reported in the scatter plots but should also be stated in some way in the results section.

Major Compulsory Revisions:. If multiple raters assessed each resident, some inter-rater reliability sample measurements would be valuable.

5. Are the discussion and conclusions well balanced and adequately supported by the data? Yes, the conclusions appropriately state that: 1. Simulation is associated with physiologic stress in trainees. 2. Heart rate correlates poorly with perceived stress and CRM/Flow performance. 3. Experience trumps stress. The conclusions are not overstated and are fair based on the study results.

Discretionary Revisions: Discussion section, first paragraph, line 1: I would suggest that you are examining the relationship between self-reported anxiety and heart rate in relation to clinical performance.

Discussion section, 2nd paragraph, 3rd line: “While participation in the both high- and low-…” Consider deleting the word “the” or flipping “the both” to “both the”.

Very minor point.

Minor Essential Revisions none

Major Compulsory Revisions none

6. Are limitations of the work clearly stated? Yes, I think it is accurate that the significant limitations of the study are 1. Single center and 2. Subjective single question self-evaluation of perceived anxiety.

Discretionary Revisions: none

Minor Essential Revisions: I can’t tell by the manuscript if all the faculty evaluators knew the residents’ PGY status and were familiar with them through clinical contact. If they were, this is a limitation that should be stated.

Major Compulsory Revisions: none

7. Do the authors clearly acknowledge any work upon which they are building, both published and unpublished?

I thought the background section was well written.

Discretionary Revisions none

Minor Essential Revisions none

Major Compulsory Revisions none

8. Do the title and abstract accurately convey what has been found?

Discretionary Revisions: My opinion is that the title does not convey the substance of the manuscript. Really the only physiologic marker is heart rate. This study is more specifically about stress response and clinical performance.
This is my opinion only.
Minor Essential Revisions: none
Major Compulsory Revisions: none

9. Is the writing acceptable? Yes, suggested minor writing revisions are noted in the sections above.
Discretionary Revisions: none
Minor Essential Revisions: none
Major Compulsory Revisions: none

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Level of interest: An article of importance in its field

Quality of written English: Acceptable

Statistical review: Yes, but I do not feel adequately qualified to assess the statistics.

Declaration of competing interests:
I declare that I have no competing interests.