

PEER REVIEW HISTORY

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ARTICLE DETAILS

TITLE (PROVISIONAL)	Using multimedia tools and high-fidelity simulations to improve medical students' resuscitation performance: an observational study
AUTHORS	Wang, Candice; Huang, Chin-Chou; Lin, Shing-Jong; Chen, Jaw-Wen

VERSION 1 – REVIEW

REVIEWER	Jesung You Department of Emergency Medicine, Yonsei University College of Medicine
REVIEW RETURNED	30-Apr-2016

GENERAL COMMENTS	<p>The authors represented several educational tools improved resuscitation performances. This paper provide new and important concepts of CPR education. It is well written except statistical methods and results</p> <p>However, authors need to revise and clarify some points 1. As authors commented, authors clarify sample size with statistical methods. 2. Please, clarify process of study with figure or illustration 3. Clarify, statistically, comparison of pre or post in Method A and B (Table 4,5) I can not find significant differences in Table 4, and 5 Readers can be questionable - it is not significant differences in most items between method A ad B. Totally, I am also questionable educational effects of method A and B Clarify this point.</p>
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REVIEWER	Susan Brien Royal College of Physicians and Surgeons of Canada Canada
REVIEW RETURNED	08-May-2016

GENERAL COMMENTS	<p>The authors set out to further understand the value of inserting an instructional video into the CPR training series of medical students with the goal to improve team training skills. The limitations of the study make it difficult to support the conclusions. There were no control groups nor groups assessed with only the instructional video. The first part of the data showed that the addition of a video prior to the CPR simulation instruction had no impact of the outcomes. Unclear why they selected the assessment tools and whether these are valid. They discussed major findings which included "leadership and team skills improve with training". Cook et al in their well</p>
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	documented metaanalysis showed that training is better than no training.
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REVIEWER	Amy Lin, PharmD University of California, San Diego Medical Center USA
REVIEW RETURNED	13-May-2016

GENERAL COMMENTS	<p>Thank you for the opportunity to review an interesting manuscript by Wang and colleagues. In this study the authors report the impact of using an instructional video and high-fidelity simulation on medical student performance in a resuscitation team. The use of a high-fidelity simulator is especially exciting because it is a technologically advanced method of training and relatively novel to the medical field. Findings from two teaching strategies demonstrate that the combination of both methods improve overall performance and suggest that video exposure prior to a simulation experience increases student leadership skills. Overall, the authors should be commended on their efforts to evaluate different training methods to improve medical student performance. Please see below for questions and suggestions:</p> <p>Major comments</p> <ol style="list-style-type: none"> 1. Strengths and limitations – The points described on Page 4 summarize the study and should instead describe how the authors' findings may or may not benefit the medical community, and how the results can be used or applied at other institutions. 2. Design – Is the 1st and 2nd simulation the same case? Please describe. If so, this should be mentioned as a limitation because skill improvement may be due to the repeat evaluation of the same scenario within a short time frame. 3. Design – What are the roles of each medical student in the groups? Is each student being scored individually or is there an elected group leader that is being scored? 4. Results – On Page 12, Line 36, the authors describe significantly higher simulation scores in leadership for Method A compared to Method B ($p=0.0034$) but is not listed as a result in Table 5. If there are overall scores for each category, please include in the table especially if the authors are claiming significance. 5. Discussion – On Page 14, Lines 8-10, the 2nd major finding should more clearly articulate that the results are from the comparison of a video viewing as opposed to no video at all. Otherwise, the 2nd and 3rd major findings seem to contradict each other. 6. Discussion – Would recommend rewording sentence beginning on Page 14, Line 53. In addition to a few grammatical problems, this is the first mention of a hypothesis in the manuscript. If the authors would like to present this hypothesis, it should be mentioned in the abstract objective as well as the last paragraph of the introduction.
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	<p>7. Discussion – Who responds to codes at the Taipei Veterans General Hospital and how are the responsibilities distributed? Describing this could increase the validity of this study.</p> <p>8. Conclusion – The authors' conclusion that Method A increases student leadership skills compared to Method B is perhaps too bold of a statement since Table 5 demonstrates that there was no significant difference in all categories, except for the support subcategory. A more appropriate conclusion may be that both methods improved global rating scores as a primary outcome, and that using the instructional video prior to 1st simulation significantly increased support within the leadership category as a secondary finding.</p> <p>Minor comments</p> <ol style="list-style-type: none"> 1. All p values should be in lower-case. 2. Please clarify the sentence on Page 11, Lines 18-22. It would be more accurate to state "... leadership, teamwork, and team member skills ($p < 0.001$)" than to have the p-value listed after each category because Table 1 lists quite a few insignificant findings under the team member category. 3. The inclusion of Table 4 is unnecessary since there were no significant findings, unless the authors would like to comment on the trend towards improved communication in Method A? 4. Tables should be referenced only once at the end of the paragraph if the preceding sentences are discussing the same table. 5. On Page 14, Line 22, consider rewording "our studies show" to "our study shows" since this is a singular study, unless the authors are referring to previous studies they have published? 6. Consider using less parentheses throughout the manuscript as it can detract from the main point of the sentence and make the paper difficult to read. Suggest to edit Page 2, Lines 26, 37-42, and 48-51, paragraphs 3-5 in the "real-time evaluation" section on Pages 8-9, and Page 15, Lines 10-12. 7. In general, the manuscript reads very casually and could be improved with a few grammatical revisions and the use of a more formal tone.
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REVIEWER	Sissel Eikeland Husebø University of Stavanger, Stavanger, Norway
REVIEW RETURNED	20-May-2016

GENERAL COMMENTS	<p>General comments: The language should be checked by a native English speaker. Many of the references are too old and should be replaced with new references. The main terms and concepts should be defined and used consequently in the manuscript. The method section has to be strengthened.</p> <p>P2-3, No.4-57 and 3-21. Update the Abstract in line with the</p>
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	<p>comments and suggestions below.</p> <p>P4, No. 3-20. Strengths and limitations of this study.</p> <p>The study has several limitations that should appear in bullet points.</p> <p>P5</p> <p>No. 8. Please include several new (after 2010) references in addition to ref.1.</p> <p>No. 26-28. Consider to replace with the following "this indicates that a variety of didactic methods may be needed....."</p> <p>No. 37-40. There is a difference between "simulation" as a pedagogical method and "a high fidelity simulator" which is the tool in use. To clarify the concept, please define "simulation" and use the term consequently in the manuscript.</p> <p>No. 42. Do you mean team and leadership skills or team and leadership strategies? Are there difference between skills and strategies?</p> <p>No. 46-50. This part has to be developed, since the order of using an instructional video is the only difference between Method A and B. The rationale for using an instructional video as the first pedagogical method for one of the student groups has to be addressed by referring to previous results in studies related to use of instructional video in CPR-training. Is it possible to learn CPR by only observing and not performing? I suggest something like: "Multimedia tools for learning CPR skill in medical education have shown". The reference from 1997 is too old.</p> <p>No. 53-55. Do you mean: "It will be interesting to investigate the joints effects of an instructional CPR video exposure compared to". It's confusing when you use the term "classroom-based instruction", which is not included in the abstract, when I suppose you mean simulation?</p> <p>P6</p> <p>No. 3-10. Consider if the objective of the study has to be reformulated followed by the relevant research questions. Consider if the term "to optimize CPR understanding and success using simulation....." can be used since the data collected is observational.</p> <p>P7</p> <p>The structure and some of the content of the method section has to be revised. I suggest the following order: Design, Participants and ethics, the CPR training session, data collection and data analysis.</p> <p>No. 15. Start with explaining the Design of the study and add that the training was provided for medical students in year 5-7.</p> <p>No.19. Revise to "During each session, we divided...."</p> <p>No.21. I suggest: "During (number of months or years), we trained....."</p> <p>A question: It is important to know if the medical students had any</p>
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	<p>prior knowledge, skills or experience of CPR due to the weak design of the study. One explanation of the significant results might be that the groups were different (knowledge, skills, age and gender) initially (and students were not randomized to Method A and B), which has to be addressed in the "Discussion" section.</p> <p>No. 17-32. To get an overview of all parts of the 2-hour session I will recommend to insert a figure, also viewing the observations and rating made by whom during the session. This will make it easier to follow the explanations from no.24 to 38.</p> <p>In the Participants section, the selection process of the sample to Method A and B is missing.</p> <p>No. 49 to 17, P8. All parts, not only the instructional resuscitation video, and content of the 2-hour training sessions has to be described, including content and duration of the first CPR simulation, debriefing and the second CPR simulation. I question use of a CPR video from 2005, since new guidelines are published every five years. How was this addressed?</p> <p>P8-9</p> <p>No. 21 to 41 P9. In my view this is the weakest part of the section due to only one assessor and use of a checklist comprised of three categories which is not published nor is the validation process transparent. I will suggest that the checklist rating form is attached and that the validation process is described in more detail. Only one assessor can be a threat to validity, i.e. how much can we trust on the subjective rating using an objective? checklist developed by the institute. Since you have video recordings of the simulations, I recommend the method used in the following reference where two independent assessors rated the simulations.</p> <p><i>Husebø et al. (2012). A comparative study of defibrillation and cardiopulmonary resuscitation performance during simulated cardiac arrest in nursing student teams. Scandinavian Journal of Trauma, Resuscitation and Emergency Medicine, 20:23, doi:10.1186/1757-7241-20-23.</i></p> <p>I recommend two independent assessors rating the reaction times in the video recordings.</p> <p>P11</p> <p>no.8-13. Consider to add participants characteristics i.e. students average age and if group size were different.</p> <p>No.25. and 40 revise to "were significantly higher"</p> <p>P12</p> <p>No. 19-21. Consider to merge the two sentences into one sentence.</p>
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	P14 No. 26. The reference is too old. No. 21-39. It is not clear if the studies you are referring to include medical student or professionals. Since it is medical students that are participating in your study, I will recommend using studies with similar sample. P15, no.57. The reference is from 2002 and too old. P17. no. 5-19. The current manuscript has many limitations that you have to address in this section. No. 26-32. I miss implications for education and research
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VERSION 1 – AUTHOR RESPONSE

RESPONSE TO REVIEWER 1'S COMMENTS:

The authors represented several educational tools improved resuscitation performances. This paper provides new and important concepts of CPR education.

It is well written except statistical methods and results

However, authors need to revise and clarify some points

1. As authors commented, authors clarify sample size with statistical methods.

Ans: Thank you for the comments. We have mentioned the small sample size in our study limitations section. A further study is needed to verify these findings with a larger sample.

2. Please, clarify process of study with figure or illustration

Ans: Thank you for the comments. We have added a flow chart of the study (Figure 1).

3. Clarify, statistically, comparison of pre or post in Method A and B (Table 4,5) I cannot find significant differences in Table 4, and 5

Readers can be questionable - it is not significant differences in most items between method A and B. Totally, I am also questionable educational effects of method A and B Clarify this point.

Ans: Thank you for the comments. Sorry for the unclear presentation of the Tables. We have merged the previous Table 4 and Table 5 into a new Table 5 (Table 5). We presented the overall category scores in Table 5. As we mentioned in the RESULTS section, our data showed that Method A increased scores in the student leadership category ($P= 0.034$).

RESPONSE TO REVIEWER 2'S COMMENTS:

The authors set out to further understand the value of inserting an instructional video into the CPR training series of medical students with the goal to improve team training skills. The limitations of the

study make it difficult to support the conclusions.

There were no control groups nor groups assessed with only the instructional video.

Ans: Thank you for the comments. We have addressed this in our study limitations.

"Our study has some limitations. The first is the lack of a control group who never watched the video or who did not engage in a first CPR simulation. Due to the ethical prioritization of student learning experiences, all student groups received a first CPR simulation and video showing, though in varying chronological orders." (Page 18, Study limitations, lines 1-4)

The first part of the data showed that the addition of a video prior to the CPR simulation instruction had no impact of the outcomes. Unclear why they selected the assessment tools and whether these are valid.

Ans: Thank you for the comments. The evaluation form is an observational tool. The content validity was established by 1 cardiologist, 1 emergency physician, and 1 nursing specialist at our institute (Appendix 1). (Page 10, paragraph 3)

They discussed major findings which included "leadership and team skills improve with training". Cook et al in their well-documented meta-analysis showed that training is better than no training.

Ans: Thank you for the comments. We have revised our manuscript and cited the reference.

"Our study shows that overall, students' leadership, teamwork, and team member skills can be improved after CPR training. The finding is consistent with the meta-analysis that technology-enhanced simulation training is effective in health professions education.⁷" (Page 15, Training improves leadership, teamwork, and team member skills, paragraph 1, lines 1-3)

References:

7. Cook DA, Hatala R, Brydges R, et al. Technology-enhanced simulation for health professions education: a systematic review and meta-analysis. JAMA 2011;306:978-88.

RESPONSE TO REVIEWER 3'S COMMENTS:

Thank you for the opportunity to review an interesting manuscript by Wang and colleagues. In this study the authors report the impact of using an instructional video and high-fidelity simulation on medical student performance in a resuscitation team. The use of a high-fidelity simulator is especially exciting because it is a technologically advanced method of training and relatively novel to the medical field. Findings from two teaching strategies demonstrate that the combination of both methods improve overall performance and suggest that video exposure prior to a simulation experience increases student leadership skills. Overall, the authors should be commended on their efforts to evaluate different training methods to improve medical student performance. Please see below for questions and suggestions:

Major comments

1. Strengths and limitations – The points described on Page 4 summarize the study and should instead describe how the authors' findings may or may not benefit the medical community, and how the results can be used or applied at other institutions.

Ans: Thank you for the comments. We had revised the Strengths and Limitations section.

λ Although the study was designed only observationally, the baseline characteristics of the participants in the 2 method groups were similar, including gender, degree, experience on resuscitation, and student numbers in each team.

λ Due to the ethical prioritization of student learning experiences, all student groups received both a first CPR simulation and video showing, though in varying chronological orders.

- λ The allocation of the students in two methods was random; student groups were trained by video exposure followed by a first CPR simulation (Method A) during even numbered months, and by a first CPR simulation followed by video exposure (Method B) during odd numbered months.
- λ The evaluation process included real-time evaluation by one attending physician who taught the students, and video-recording evaluation by another two independent individuals.

2. Design – Is the 1st and 2nd simulation the same case? Please describe. If so, this should be mentioned as a limitation because skill improvement may be due to the repeat evaluation of the same scenario within a short time frame.

Ans: Thank you for the comments. I am sorry that we didn't mention it clearly. We have revised it in the METHOD section.

"In the CPR simulations, there were 4 different scenarios of in-hospital cardiac arrest. The CPR procedures were similar because all 4 scenarios included ventricular fibrillation/ventricular tachycardia and pulseless-electrical-activity/asystole. The simulations were practiced using a high-fidelity simulator (Simman, Laerdal Medical Corporation, New Year, USA)." (Page 7, Method, Design, paragraph 2)

3. Design – What are the roles of each medical student in the groups? Is each student being scored individually or is there an elected group leader that is being scored?

Ans: Thank you for the comments. Each group consisted of four to six team members. During the simulation, a leader and team members must cooperate to perform various tasks at the same time (such as chest compression, ambu bagging, defibrillation, etc.).

Evaluation processes for the first and second CPR simulation were the same. Each team was assessed as one unit using a formal evaluation form that included checklist rating scores and global rating scores (Appendix 1). (Pages 8-10, Real-time evaluation)

4. Results – On Page 12, Line 36, the authors describe significantly higher simulation scores in leadership for Method A compared to Method B ($p=0.034$) but is not listed as a result in Table 5. If there are overall scores for each category, please include in the table especially if the authors are claiming significance.

Ans: Thank you for the comments. Sorry for the unclear presentation of the Tables. We have merged the previous Table 4 and Table 5 into a new Table 5 (Table 5). We presented the overall category scores in the Table 5. We also added the overall scores for each category in other Tables (Table 2-4).

5. Discussion – On Page 14, Lines 8-10, the 2nd major finding should more clearly articulate that the results are from the comparison of a video viewing as opposed to no video at all. Otherwise, the 2nd and 3rd major findings seem to contradict each other.

Ans: Thank you for the comments. We have revised the sentences.

"(2) in the first CPR simulation, an initial movie did not produce greater improvement in leadership, teamwork, and team member skills; (3) in the second CPR simulation, Method A's video exposure followed by first CPR simulation further increased student leadership skills compared to a Method B's first CPR simulation followed by video exposure." (Page 15, DISCUSSION, paragraph 1, lines 2-6)

6. Discussion – Would recommend rewording sentence beginning on Page 14, Line 53. In addition to a few grammatical problems, this is the first mention of a hypothesis in the manuscript. If the authors would like to present this hypothesis, it should be mentioned in the abstract objective as well as the last paragraph of the introduction.

Ans: Thank you for the comments. We have revised the sentences.

"Our study found that video showing and a first CPR simulation can improve students' second CPR simulation skills in: organization, order delivery, teammate support, and awareness in the leadership category; communication, cooperation, experience sharing, ACLS adherence, and task completion in the teamwork category; and effective/correct patient contact, chest compression, and IV medication in the team member skills category." (Page 15, Training improves leadership, teamwork, and team member skills, paragraph 2 – Page 16, line 3)

7. Discussion – Who responds to codes at the Taipei Veterans General Hospital and how are the responsibilities distributed? Describing this could increase the validity of this study.

Ans: Thank you for the comments. One research assistant of the institute was in charge of data collection and coding. We had added the information in the manuscript. (Page 8, lines 1-2)

8. Conclusion – The authors' conclusion that Method A increases student leadership skills compared to Method B is perhaps too bold of a statement since Table 5 demonstrates that there was no significant difference in all categories, except for the support subcategory. A more appropriate conclusion may be that both methods improved global rating scores as a primary outcome, and that using the instructional video prior to 1st simulation significantly increased support within the leadership category as a secondary finding.

Ans: Thank you for the comments. Sorry for the unclear presentation of the Tables. We have merged the previous Table 4 and Table 5 into a new Table 5 (Table 5). We presented the overall category scores in the Table 5. As we mentioned in RESULT section, our data showed that Method A increased student scores in the leadership category ($P= 0.034$).

Minor comments

1. All p values should be in lower-case.

Ans: Thank you for the comments. We have revised the manuscript and the tables.

2. Please clarify the sentence on Page 11, Lines 18-22. It would be more accurate to state "leadership, teamwork, and team member skills ($p< 0.001$)" than to have the p-value listed after each category because Table 1 lists quite a few insignificant findings under the team member category.

Ans: Thank you for the comments. Sorry for the unclear presentation of the tables. The overall scores in leadership and teamwork of second simulation were higher than first simulation. We had added the overall category scores for each category in the tables (Table 2-5).

3. The inclusion of Table 4 is unnecessary since there were no significant findings, unless the authors would like to comment on the trend towards improved communication in Method A?

Ans: Thank you for the comments. Sorry for the unclear presentation of the Tables. We have merged the previous Table 4 and Table 5 into a new Table 5 (Table 5).

4. Tables should be referenced only once at the end of the paragraph if the preceding sentences are discussing the same table.

Ans: Thank you for the comments. We have revised it in the RESULTS.

5. On Page 14, Line 22, consider rewording "our studies show" to "our study shows" since this is a

singular study, unless the authors are referring to previous studies they have published?

Ans: Thank you for the suggestion. We have corrected it. (Page 15, DISCUSSION, Training improves leadership, teamwork, and team member skills, paragraph 1, line 1)

6. Consider using less parentheses throughout the manuscript as it can detract from the main point of the sentence and make the paper difficult to read. Suggest to edit Page 2, Lines 26, 37-42, and 48-51, paragraphs 3-5 in the “real-time evaluation” section on Pages 8-9, and Page 15, Lines 10-12.

Ans: Thank you for the comments. We have revised our manuscript and deleted the parentheses.

(Page 2, Abstract; Pages 8-9, METHOD, Real-time evaluation; Page 16, lines 4-5; Page 16, An initial movie did not improve leadership, teamwork, and team member skills, line 4)

7. In general, the manuscript reads very casually and could be improved with a few grammatical revisions and the use of a more formal tone.

Ans: Thank you for the comments. We have revised the manuscript according to your suggestion.

RESPONSE TO REVIEWER 4'S COMMENTS:

General comments: The language should be checked by a native English speaker. Many of the references are too old and should be replaced with new references. The main terms and concepts should be defined and used consequently in the manuscript. The method section has to be strengthened.

Ans: Thank you for the kindly comments and suggestions. We have revised the paper according to your suggestions.

P2-3, No.4-57 and 3-21. Update the Abstract in line with the comments and suggestions below.

Ans: Thank you for the comments. We have revised the Abstract according to your comments and suggestions. (Pages 2-3, Abstract)

P4, No. 3-20. Strengths and limitations of this study.

The study has several limitations that should appear in bullet points.

Ans: Thank you for the comments. We had revised the Strengths and Limitations section.

λ Although the study was designed only observationally, the baseline characteristics of the participants in the 2 method groups were similar, including gender, degree, experience on resuscitation, and student numbers in each team.

λ Due to the ethical prioritization of student learning experiences, all student groups received both a first CPR simulation and video showing, though in varying chronological orders.

λ The allocation of the students in two methods was random; student groups were trained by video exposure followed by a first CPR simulation (Method A) during even numbered months, and by a first CPR simulation followed by video exposure (Method B) during odd numbered months.

λ The evaluation process included real-time evaluation by one attending physician who taught the students, and video-recording evaluation by another two independent individuals.

P5, No. 8. Please include several new (after 2010) references in addition to ref.1.

Ans: Thank you for the comments. We have replaced the reference with two new references.

References:

1. Hasselqvist-Ax I, Riva G, Herlitz J, et al. Early cardiopulmonary resuscitation in out-of-hospital

cardiac arrest. *N Engl J Med* 2015;372:2307-15.

2. Talikowska M, Tohira H, Finn J. Cardiopulmonary resuscitation quality and patient survival outcome in cardiac arrest: A systematic review and meta-analysis. *Resuscitation* 2015;96:66-77.

P5, No. 26-28. Consider to replace with the following “this indicates that a variety of didactic methods may be needed.....”

Ans: Thank you for the suggestion. We have revised it according to your suggestion. (Page 5, INTRODUCTION, paragraph 1, lines 10-11)

P5, No. 37-40. There is a difference between “simulation” as a pedagogical method and “a high fidelity simulator” which is the tool in use. To clarify the concept, please define “simulation” and use the term consequently in the manuscript.

Ans: Thank you for the comments.

We have revised the paper and used the term “high-fidelity simulations” throughout the manuscript. (Page 2, Abstract, lines 3-4; Page 5, INTRODUCTION, paragraph 2, line 4; Page 6, line 2)

We also added a paragraph to describe the CPR simulations in our study: “In the CPR simulations, there were 4 different scenarios of in-hospital cardiac arrest. The CPR procedures were similar because all 4 scenarios included ventricular fibrillation/ventricular tachycardia and pulseless-electrical-activity/asystole. The simulations were practiced using a high-fidelity simulator (Simman, Laerdal Medical Corporation, New Year, USA).” (Page 7, METHOD, Design, paragraph 2)

P5, No. 42. Do you mean team and leadership skills or team and leadership strategies? Are there difference between skills and strategies?

Ans: Thank you for the comments. We have revised it to “team/leadership skills.” (Page 5, paragraph 2, line 6)

P5, No. 46-50. This part has to be developed, since the order of using an instructional video is the only difference between Method A and B. The rationale for using an instructional video as the first pedagogical method for one of the student groups has to be addressed by referring to previous results in studies related to use of instructional video in CPR-training. Is it possible to learn CPR by only observing and not performing? I suggest something like: “Multimedia tools for learning CPR skill in medical education have shown” The reference from 1997 is too old.

Ans: Thank you for the comments and suggestions. We had revised the manuscript and replaced the references.

“Multimedia tools for learning CPR skills in medical education have shown to be beneficial. One study showed that a brief CPR video training resulted in improved CPR quality and responsiveness among high school students.¹⁶ In another study comparing traditional lectures for teaching resuscitation scenarios versus video-based instruction versus low or high-fidelity simulation activities, students with video-based or simulation-based training displayed greater skill performance.¹⁷” (Page 5, INTRODUCTION, paragraph 3, lines 1-6)

Reference:

16. Beskind DL, Stoltz U, Thiede R, et al. Viewing a brief chest-compression-only CPR video improves bystander CPR performance and responsiveness in high school students: A cluster randomized trial. *Resuscitation* 2016;104:28-33.
17. Adams AJ, Wasson EA, Admire JR, et al. A Comparison of Teaching Modalities and Fidelity of Simulation Levels in Teaching Resuscitation Scenarios. *J Surg Educ* 2015;72:778-85.

P5, No. 53-55. Do you mean: "It will be interesting to investigate the joints effects of an instructional CPR video exposure compared to". It's confusing when you use the term "classroom-based instruction", which is not included in the abstract, when I suppose you mean simulation?

Ans: Thank you for the comments. The main theme of our study included multimedia tools and high-fidelity simulations. We have revised the title to "Using multimedia tools and high-fidelity simulations to improve medical students' resuscitation performance: an observational study." We have also revised the manuscript.

"It is thus important to consider the joint effects of training video exposure and high-fidelity simulations" (Page 6, lines 1-2)

P6, No. 3-10. Consider if the objective of the study has to be reformulated followed by the relevant research questions. Consider if the term "to optimize CPR understanding and success using simulation....." can be used since the data collected is observational.

Ans: Thank you for the comments. We have revised the manuscript.

"The goal of our study was to investigate the joint effects of multimedia tools and high-fidelity simulations with varying chronological orders. The findings of our study will help us to shed light on educational methods to strengthen medical students' CPR leadership and team skills in order to optimize CPR understanding and success." (Page 6, paragraph 2)

P7, The structure and some of the content of the method section has to be revised. I suggest the following order: Design, Participants and ethics, the CPR training session, data collection and data analysis.

Ans: Thank you for the suggestion. We have revised it according to your suggestion. (Pages 7-11, METHOD)

P7, No. 15. Start with explaining the Design of the study and add that the training was provided for medical students in year 5-7.

Ans: Thank you for the suggestion. We have revised it according to your suggestion. (Page 7, METHOD, Design, paragraph 1, lines 1-2)

P7, No.19. Revise to "During each session, we divided...."

Ans: Thank you for the suggestion. We have revised it according to your suggestion. (Page 7, METHOD, Design, paragraph 1, line 2)

P7, No.21. I suggest: "During (number of months or years), we trained....."

A question: It is important to know if the medical students had any prior knowledge, skills or experience of CPR due to the weak design of the study. One explanation of the significant results might be that the groups were different (knowledge, skills, age and gender) initially (and students were not randomized to Method A and B), which has to be addressed in the "Discussion" section.

Ans: Thank you for the suggestion. We have revised it according to your suggestion.

"Across 13 months, we trained student groups with either Method A or Method B. During even numbered months, student groups were trained with Method A. During odd numbered months, student groups were trained with Method B." (Page 7, METHOD, Design, paragraph 1, lines 3-5)
We have also provided the baseline data of the participants.

"We enrolled 104 medical students (72 male and 32 female) in the study, including 33 7th year medical students, 14 6th year medical students, and 57 5th year medical students. 63 (60.6%)

students had previous resuscitation experience. We divided all students into 22 teams. We then trained 11 teams using Method A and 11 using Method B. There were no differences in the baseline characteristics of the participants trained by each method. The mean student numbers in each team of the two methods were also similar (Method A versus Method B= 4.5 ± 0.5 versus 4.9 ± 0.8 , $p=0.236$) (Table 1). Each student group completed first and second CPR simulations during its 2-hour training session." (Page 12, RESULTS, Participants)

We also added this part in our study limitation.

"Third, the study was designed only observationally and we did not match the baseline characteristics of the participants in Method A and B groups. However, the baseline characteristics of the participants in two groups were similar, including gender, degree, experience on resuscitation, and student numbers in each team." (Page 18, Study limitations, lines 6-10)

P7, No. 17-32. To get an overview of all parts of the 2-hour session I will recommend to insert a figure, also viewing the observations and rating made by whom during the session. This will make it easier to follow the explanations from no.24 to 38.

In the Participants section, the selection process of the sample to Method A and B is missing.

Ans: Thank you for the suggestions. We have added a flow chart of the study (Figure 1).

Furthermore, we have added the selection process of the sample to Method A and B in study design section: "During even numbered months, student groups were trained with Method A. During odd numbered months, student groups were trained with Method B." (Page 7, METHOD, Design, paragraph 1, lines 4-5)

P7, No. 49 to 17, P8. All parts, not only the instructional resuscitation video, and content of the 2-hour training sessions has to be described, including content and duration of the first CPR simulation, debriefing and the second CPR simulation. I question use of a CPR video from 2005, since new guidelines are published every five year. How was this addressed?

Ans: Thank you for the comments. Sorry for the unclear presentation. We have added a figure to improve the understanding of the 2-hour training sessions. (Figure 1)

During the resuscitation training, we followed the updated guideline. Although we used the CPR video was from 2005, the main concepts of the video included elements of team dynamics, team leader traits, and team member traits, which were unchanged. We had added this part in our study limitations.

"Finally, our CPR video was from 2005. During the resuscitation training, we followed the updated CPR guidelines. Although the CPR video was old, the main concepts of the video included elements of team dynamics, team leader traits, and team member traits, which were still pertinent." (Page 18, Study limitations, lines 3-6)

P8-9, No. 21 to 41 P9. In my view this is the weakest part of the section due to only one assessor and use of a checklist comprised of three categories which is not published nor is the validation process transparent. I will suggest that the checklist rating form is attached and that the validation process is described in more detail. Only one assessor can be a threat to validity, i.e. how much can we trust on the subjective rating using an objective? checklist developed by the institute. Since you have video recordings of the simulations, I recommend the method used in the following reference where two independent assessors rated the simulations.

Husebø et al. (2012). A comparative study of defibrillation and cardiopulmonary resuscitation performance during simulated cardiac arrest in nursing student teams. Scandinavian Journal of Trauma, Resuscitation and Emergency Medicine, 20:23, doi:10.1186/1757-7241-20-23.

I recommend two independent assessors rating the reaction times in the video recordings.

Ans: Thank you for the comments and suggestions. The evaluation process included real-time

evaluation by one single attending physician who taught the students and video-recording evaluation by another two independent individuals. It was a study limitation that the real-time evaluation was done by only one attending physician. We have mentioned this in our study limitation.

"Fourth, the evaluation process included real-time evaluation by one attending physician who taught the students and video-recording evaluation by another two independent individuals. There may be bias in the real-time evaluation by only one attending physician. However, we compared the attending physician's rating scores for 40 simulation rounds with that of one nursing practitioner using the same evaluation form in the preliminary status of the study and found that the rating scores were similar among the 2 raters (Appendix 2)." (Page 17, Study limitations, line 10 – Page 18, line 3)

The evaluation form is an observational tool. The evaluation form using the same checklist rating scores was used in another study, which was just accepted by another journal (reference 18). We have revised the manuscript.

"The evaluation form is an observational tool. The content validity was established by 1 cardiologist, 1 emergency physician, and 1 nursing specialist at our institute (Appendix 1)." (Page 10, paragraph 3)

Thank you so much for offering the important reference. Video-recording evaluation was done again by another two independent individuals. Reaction times of chest compression were defined as the time from discovery of unconsciousness until chest compressions started. Reaction times of defibrillation were defined as the time from discovery of unconsciousness until shock was delivered.¹⁸ We have revised the METHOD, RESULTS and DISCUSSION extensively. (Page 10, Video-recording evaluation; Page 11, paragraph 2; Page 14, Comparing the completion frequencies and reaction times of each procedural step of Method A and Method B, Pages 17-18, Improvement of chest compression reaction times during first CPR simulations versus second CPR simulations)

Reference:

18. Eikeland Husebø SI, Bjørshol CA, Rystedt H, Friberg F, Søreide E. A comparative study of defibrillation and cardiopulmonary resuscitation performance during simulated cardiac arrest in nursing student teams. *Scand J Trauma Resusc Emerg Med* 2012;20:23.

P11, No.8-13. Consider to add participants characteristics i.e. students average age and if group size were different.

Ans: Thank you for the suggestions. I am sorry that we didn't have the accurate age of the participants. However, there were no differences in other baseline characteristics of the participants trained by each method, including gender, degree, and previous resuscitation experience. The mean student numbers in each team of the two methods were also similar (Method A versus Method B= 4.5 ± 0.5 versus 4.9 ± 0.8, p= 0.236) (Table 1). (Page 12, RESULTS, Participants; Page 18, Study limitations, lines 6-10)

P11, No.25. and 40 revise to "were significantly higher"

Ans: Thank you for the suggestion. We have revised it according to your suggestion. (Page 12, RESULTS, Comparing the first and second CPR simulation scores in all groups, paragraph 1, lines 4, 7, and 11)

P12, No. 19-21. Consider to merge the two sentences into one sentence.

Ans: Thank you for the suggestion. We have revised the manuscript.

"The first CPR simulation scores in leadership, teamwork, team member skills, and global rating scores did not differ significantly between students taught by Method A versus Method B (Table 5)." (Page 13, RESULTS, Comparing the first CPR simulation scores of Method A and Method B)

P14, No. 26. The reference is too old.

Ans: Thank you for the comments. We have replaced the old references. We also modified the DISCUSSION accordingly.

"Our study shows that overall, students' leadership, teamwork, and team member skills can be improved after CPR training. The finding is consistent with the meta-analysis that technology-enhanced simulation training is effective in health professions education.⁷" (Page 15, Training improves leadership, teamwork, and team member skills, paragraph 1, lines 1-3)

References:

7. Cook DA, Hatala R, Brydges R, et al. Technology-enhanced simulation for health professions education: a systematic review and meta-analysis. JAMA 2011;306:978-88.

P14, No. 21-39. It is not clear if the studies you are referring to include medical student or professionals. Since it is medical students that are participating in your study, I will recommend using studies with similar sample.

Ans: Thank you for the comments. The participants of the two referenced studies were medical students (reference 9 and 10). We replaced one reference with another study conducted in medical students (reference 8). We have revised this manuscript accordingly.

"Medical student training and experience in cardiac arrest situations is limited. One study showed that ACLS training with high-fidelity simulations significantly improved knowledge and psychomotor skills in medical students.⁸" (Page 15, Training improves leadership, teamwork, and team member skills, paragraph 1, lines 4-6)

References:

8. Langdorf MI, Strom SL, Yang L, et al. High-fidelity simulation enhances ACLS training. Teach Learn Med 2014;26:266-73.

P15, No.57. The reference is from 2002 and too old.

Ans: Thank you for the comments. We have replaced the reference.

P17, No. 5-19. The current manuscript has many limitations that you have to address in this section.

Ans: Thank you for the comments. We have added another three study limitations. (Pages 18-19, study limitations)

P17, No. 26-32. I miss implications for education and research.

Ans: Thank you for the comments. We have revised our CONCLUSION and added the implications of our study.

"Although both teaching strategies improved leadership, teamwork, and team member performance, Method A's video exposure followed by first CPR simulation further increased student leadership skills compared to a Method B's first CPR simulation followed by video exposure. This finding supports that initial video instruction followed by CPR simulation is a better strategy for leadership skills training. However, the study was limited due to its observational design and small sample size. Further studies are still necessary to clarify our findings." (Page 19, CONCLUSION)

VERSION 2 – REVIEW

REVIEWER	Amy Lin University of California San Diego Medical Center San Diego, CA United States
REVIEW RETURNED	24-Jul-2016

GENERAL COMMENTS	<p>Thank you again for the opportunity to evaluate this manuscript by Wang and colleagues and I would like to thank the authors for addressing my questions from the previous review. Overall, there have been major improvements in clarifying the design and describing the findings of this study, but I would advise the paper be inspected for grammatical accuracy to enhance reader experience. Please see below for my comments:</p> <ol style="list-style-type: none"> 1. Design, last paragraph – Is SimMan is from New “York” instead of New “Year”? 2. Participants, 1st paragraph – Spell out “December” instead of abbreviating 3. Instructional video, 1st paragraph – Consider rewording the 2nd sentence because it does not read very smoothly. 4. Real-time evaluation, 3rd-5th paragraph – Although I appreciate the attempt to explain each subcategory, I would suggest using variations of the phrase “which meant” since it appears many times in the same sentence. Also, consider adding the word “the” after “which meant.” 5. Real-time evaluation, 5th paragraph – Replace the forward slash in “procedures/medications” with “procedures or medications” to help with formality. 6. Results, Participants section – Instead of mentioning the similar number of students in each method, it would be interesting and more pertinent to mention the previous resuscitation experience of each group. 7. Results, Method A and Method B section – The first sentence of the third paragraph states that second simulation reaction times were significantly shorter for “all groups” which can be easily interpreted as the case for both Method A and Method B when in fact, Method B was not significant. Please reword this statement and consider changing the name of “all groups” to “overall.” 8. Discussion, 3rd paragraph – The semi-colon after “CPR simulation skills” is unnecessary
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REVIEWER	Sissel Eikeland Husebø University of Stavanger Norway
REVIEW RETURNED	19-Jul-2016

GENERAL COMMENTS	My responses are in <i>italics</i> .
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<p><i>General comments: The manuscript has been revised satisfactory according to my comments and suggestions. The references have been updated, the main terms and concepts should have been defined and are used consequently in the manuscript. The method section has been strengthened.</i></p> <p><i>The manuscript just need some minor changes.</i></p> <p>P2-3, No.4-57 and 3-21. Update the Abstract in line with the comments and suggestions below.</p> <p><i>The abstract has been updated, but "Outcome measures" should include video-recording evaluation by two independent individuals.</i></p> <p>P4, No. 3-20. Strengths and limitations of this study.</p> <p>The study has several limitations that should appear in bullet points.</p> <p><i>Addressed satisfactory</i></p> <p>P5</p> <p>No. 8. Please include several new (after 2010) references in addition to ref.1.</p> <p><i>Revised</i></p> <p>No. 26-28. Consider to replace with the following "this indicates that a variety of didactic methods may be needed....."</p> <p><i>Revised</i></p> <p>No. 37-40. There is a difference between "simulation" as a pedagogical method and "a high fidelity simulator" which is the tool in use. To clarify the concept, please define "simulation" and use the term consequently in the manuscript.</p> <p><i>Fulfilled satisfactory</i></p> <p>No. 42. Do you mean team and leadership skills or team and leadership strategies? Are there difference between skills and strategies?</p> <p><i>Revised</i></p> <p>No. 46-50. This part has to be developed, since the order of using an instructional video is the only difference between Method A and B. The rationale for using an instructional video as the first pedagogical method for one of the student groups has to be addressed by referring to previous results in studies related to use of instructional video in CPR-training. Is it possible to learn CPR by only observing and not performing? I suggest something like: "Multimedia tools for learning CPR skill in medical education have shown". The reference from 1997 is too old.</p> <p><i>Revised satisfactory</i></p> <p>No. 53-55. Do you mean: "It will be interesting to investigate the joint effects of an instructional CPR video exposure compared to". It's confusing when you use the term "classroom-based instruction", which is not included in the abstract, when I suppose you mean simulation?</p>
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	<p>Revised</p> <p>P6</p> <p>No. 3-10. Consider if the objective of the study has to be reformulated followed by the relevant research questions. Consider if the term “to optimize CPR understanding and success using simulation.....” can be used since the data collected is observational.</p> <p><i>Revised satisfactory</i></p> <p>P7</p> <p>The structure and some of the content of the method section has to be revised. I suggest the following order: Design, Participants and ethics, the CPR training session, data collection and data analysis.</p> <p><i>Both content and structure of the Method section have been improved and strengthened satisfactory. Two independent assessors rating the reaction times in the video recordings have strengthened the study results.</i></p> <p><i>Please revise reference 18. to Husebø SE.....</i></p> <p>P11</p> <p>no.8-13. Consider to add participants characteristics i.e. students average age and if group size were different.</p> <p><i>Approved</i></p> <p>No.25. and 40 revise to “were significantly higher”</p> <p><i>Revised satisfactory</i></p> <p>P12</p> <p>No. 19-21. Consider to merge the two sentences into one sentence.</p> <p><i>Revised</i></p> <p>P14</p> <p>No. 26. The reference is too old.</p> <p><i>Revised satisfactory</i></p> <p>No. 21-39. It is not clear if the studies you are referring to include medical student or professionals. Since it is medical students that are participating in your study, I will recommend using studies with similar sample.</p>
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	P15, no.57. The reference is from 2002 and too old. <i>Revised satisfactory</i> P17. no. 5-19. The current manuscript has many limitations that you have to address in this section. <i>Revised satisfactory</i> No. 26-32. I miss implications for education and research. <i>Revised satisfactory</i>
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VERSION 2 – AUTHOR RESPONSE

Response to Reviewer 3's comments:

Thank you again for the opportunity to evaluate this manuscript by Wang and colleagues and I would like to thank the authors for addressing my questions from the previous review. Overall, there have been major improvements in clarifying the design and describing the findings of this study, but I would advise the paper be inspected for grammatical accuracy to enhance reader experience. Please see below for my comments:

1. Design, last paragraph – Is SimMan is from New “York” instead of New “Year”?

Ans: Thank you for the correction. We have corrected it. (Page 7, METHOD, Design, paragraph 2, line 5)

2. Participants, 1st paragraph – Spell out “December” instead of abbreviating

Ans: Thank you for the suggestion. We have corrected it. (Page 7, METHOD, Participants, paragraph 1, lines 2-3)

3. Instructional video, 1st paragraph – Consider rewording the 2nd sentence because it does not read very smoothly.

Ans: Thank you for the suggestion. We have modified the sentence.

“It began with a descriptive overview of team dynamics, team leader traits, and team member traits. Elements of team dynamics included: closed-loop communication, clear messages, clear roles and responsibilities, knowing one’s limitations, knowledge sharing, constructive intervention, reevaluation and summarizing, and mutual respect. Team leader traits included: organizes the group and assigns team roles, backs up team members, models excellent team behavior, trains and coaches, and facilitates understanding. Team member traits included: prepared, well-practiced, proficient in algorithm knowledge, and committed to success.” (Page 8, Instructional video, lines 2-9)

4. Real-time evaluation, 3rd-5th paragraph – Although I appreciate the attempt to explain each subcategory, I would suggest using variations of the phrase “which meant” since it appears many times in the same sentence. Also, consider adding the word “the” after “which meant.”

Ans: Thank you for the suggestion. We have modified the paragraphs. (Page 9, paragraph 2 – page

10, paragraph 1)

5. Real-time evaluation, 5th paragraph – Replace the forward slash in “procedures/medications” with “procedures or medications” to help with formality.

Ans: Thank you for the suggestion. We have modified it. (Page 10, line 4)

6. Results, Participants section – Instead of mentioning the similar number of students in each method, it would be interesting and more pertinent to mention the previous resuscitation experience of each group.

Ans: Thank you for the suggestion. We have added one sentence to mention the previous resuscitation experience of each group. “A total of 27 students (54.0%) in Method A group and 36 students (66.7%) in Method B group had previous resuscitation experience ($p= 0.187$).. (Page 12, RESULTS, Participants, lines 4-6)

7. Results, Method A and Method B section – The first sentence of the third paragraph states that second simulation reaction times were significantly shorter for “all groups” which can be easily interpreted as the case for both Method A and Method B when in fact, Method B was not significant. Please reword this statement and consider changing the name of “all groups” to “overall.”

Ans: Thank you for the suggestion. We have changed the sentence accordingly “Overall, the chest compression reaction times of the second simulations were significantly shorter than those of the first simulations (first simulation versus second simulation= 43.3 ± 38.8 seconds versus 25.1 ± 16.4 seconds, $p= 0.020$).“ (Page 14, Comparing the completion frequencies and reaction times of each procedural step of Method A and Method B, paragraph 3, lines 1- 3)

8. Discussion, 3rd paragraph – The semi-colon after “CPR simulation skills” is unnecessary

Ans: Thank you for the comment. We have corrected it. (Page 15, DISCUSSION, Training improves leadership, teamwork, and team member skills, paragraph 2, line 2)

Response to Reviewer 4’s comments:

General comments: The manuscript has been revised satisfactory according to my comments and suggestions. The references have been updated, the main terms and concepts should have been defined and are used consequently in the manuscript. The method section has been strengthened.

The manuscript just need some minor revisions.

P2-3, No.4-57 and 3-21. Update the Abstract in line with the comments and suggestions below. The abstract has been updated, but “Outcome measures” should include video-recording evaluation by two independent individuals.

Ans: Thank you for the suggestion. We have added the video-recording evaluation in the abstract. “Student teams were assessed with checklist rating scores in leadership, teamwork, and team member skills, global rating scores by an attending physician, and video-recording evaluation by two independent individuals.“ (Page 2, ABSTRACT, Outcome measures, lines 1-3)

P4, No. 3-20. Strengths and limitations of this study.

The study has several limitations that should appear in bullet points.

Addressed satisfactory

Ans: Thank you for the comments.

P5

No. 8. Please include several new (after 2010) references in addition to ref.1. Revised
No.26-28.Consider to replace with the following "this indicates that a variety of didactic methods may be needed....."

Revised

Ans: Thank you for the comments.

No. 37-40. There is a difference between "simulation" as a pedagogical method and "a high fidelity simulator" which is the tool in use. To clarify the concept, please define "simulation" and use the term consequently in the manuscript.

Fulfilled satisfactory

Ans: Thank you for the comments.

No. 42. Do you mean team and leadership skills or team and leadership strategies? Are there difference between skills and strategies?

Revised

Ans: Thank you for the comments.

No. 46-50. This part has to be developed, since the order of using an instructional video is the only difference between Method A and B. The rationale for using an instructional video as the first pedagogical method for one of the student groups has to be addressed by referring to previous results in studies related to use of instructional video in CPR-training. Is it possible to learn CPR by only observing and not performing? I suggest something like: "Multimedia tools for learning CPR skill in medical education have shown". The reference from 1997 is too old.

Revised satisfactory

Ans: Thank you for the comments.

No. 53-55. Do you mean: "It will be interesting to investigate the joints effects of an instructional CPR video exposure compared to". It's confusing when you use the term "classroom-based instruction", which is not included in the abstract, when I suppose you mean simulation?

Revised

Ans: Thank you for the comments.

P6

No. 3-10. Consider if the objective of the study has to be reformulated followed by the relevant research questions. Consider if the term "to optimize CPR understanding and success using simulation....." can be used since the data collected is observational. Revised satisfactory
Ans: Thank you for the comments.

P7

The structure and some of the content of the method section has to be revised. I suggest the following order: Design, Participants and ethics, the CPR training session, data collection and data analysis. Both content and structure of the Method section have been improved and strengthened satisfactory. Two independent assessors rating the reaction times in the video recordings have strengthened the study results.

Please revise reference 18. to Husebø SE.....

Ans: Thank you for the comments. We have corrected it. (Page 22, reference 18)

P11

no.8-13. Consider to add participants characteristics i.e. students average age and if group size were different.

Approved

Ans: Thank you for the comments.

No.25. and 40 revise to “were significantly higher”

Revised satisfactory

Ans: Thank you for the comments.

P12

No. 19-21. Consider to merge the two sentences into one sentence.

Revised

Ans: Thank you for the comments.

P14

No. 26. The reference is too old.

Revised satisfactory

Ans: Thank you for the comments.

No. 21-39. It is not clear if the studies you are referring to include medical student or professionals. Since it is medical students that are participating in your study, I will recommend using studies with similar sample.

Ans: Thank you for the comments. The participants of the two referenced studies were medical students (references 9 and 10). We have replaced one reference with another study conducted in medical students (reference 8).

P15, no.57. The reference is from 2002 and too old.

Revised satisfactory

Ans: Thank you for the comments.

P17.

no. 5-19. The current manuscript has many limitations that you have to address in this section.

Revised satisfactory

Ans: Thank you for the comments.

No. 26-32. I miss implications for education and research. Revised satisfactory

Ans: Thank you for the comments.