Peer Review File
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Reviewer A

Kim et al investigated the role of a video-based curriculum on thoracic surgery resident education in a retrospective survey study. The authors created 43 videos of various operations performed by thoracic surgery attendings and found positive feedbacks from resident surveys. The thoracic team is clearly dedicated to resident education as demonstrated by the work that went into designing the video curriculum. I have a few concerns regarding the scientific merit of the study.

Comment 1: Although acknowledged in the limitations, there is no objective measure of the advantages of surgical videos. Instead, the primary outcome is from survey questions given to residents 12 months after their rotations. This is very susceptible to recall bias. It was unclear which videos were watched, and the true compliance to video-watching. In addition, one of the questions on the survey was whether the resident felt the videos were superior to "book." It was unclear what "books" the residents had access to, or were recommended to read. What is the program's standard education curriculum? Some newer textbooks online do include video segments, or video atlas. Due to the subjective nature of the assessment, the results do not definitively prove the author's claim that surgical videos are advantageous in resident education.

Reply 1: Thank you for your critical review of the manuscript. We agree that the earlier version of the manuscript lacked an objective measure of the advantage of surgical video. We have undertaken extensive revisions to provide more objective outcome measures. Rather than the subjective assessment measure of how useful the resident felt that the video was, we are now assessing the amount of console time as a metric of learner preparedness. We show that on average, the residents who had a video-based curriculum had control of the robot 48% compared to 11% who did not have the video-based curriculum.

Changes in the manuscript:
We made changes in the title, abstract, methods, results and discussion.

Title:
Video-Based Curriculum Improves Resident Participation During Robot-Assisted Surgery (page 1, line 2)
Abstract:

We assessed the amount of time the resident had control of the robot for their first robot-assisted hiatal hernia repair of the month with a dual console for 13 months before and after implementing the curriculum. (page 3, lines 40-42)
Analysis of the resident console time of the first robot-assisted hiatal hernia repair of the month showed a significant increase in the amount of time the resident participated in the case from 11% to 48% ($p<0.001$). (page 3, lines 50-52)
Video-based curriculum significantly increases resident participation during robot-assisted thoracic surgery. (page 4, lines 55-56)
Methods:

Next, we hypothesized that the video-based curriculum would increase the resident's participation in the operating room. We used the My Intuitive app (Intuitive Surgical, Sunnyvale, CA, USA, Figure 1) that provides information on the amount of time a person in each of the surgical consoles is controlling the robot. We assessed the time the resident had control of the robot for their first robot-assisted hiatal hernia repair of the rotation with a dual console, assessing the time periods 13 months before and after implementing the curriculum. We measured the amount of time the attending and resident had control of the robot (Figure 2). We divided it by the total time that the robot was being used in the case to derive the % of the time that the attending and the resident were each using the robot. We obtained the average % of the time before and after the video-based curriculum that the resident was using the robot. We performed a t-test to determine if there was a significant difference between the groups. $P<0.05$ was considered a significant value. (page 10, lines 172-182).
Results:

The most common operation was a robot-assisted hiatal hernia repair with fundoplication. We analyzed the resident console time of the month's first robot-assisted hiatal hernia repair. All of the residents who performed the first robot-assisted hiatal hernia repair were chief residents. During the 13 months before implementing the video-based curriculum, the residents spent on average 11% of the time controlling the robot during the case. After the implementation of the program, the resident spent significantly more time controlling the robot (48%, $p<0.001$, Figure 3) (page 11-12, lines 215-220).
Conclusions:
Our study is unique in that we can objectively quantify the trainee's participation during an operation. Up to this point, participation has been gauged by subjective questionnaires from the learner or instructor asking about autonomy and parts of the surgery performed by the trainee. While this can still be useful, there is a lot of variability in definitions of autonomy, and therefore there is a gap in objective data. With the My Intuitive App, there is greater transparency and quantifiable data regarding trainee participation. While at this point, we are not using the data to identify what parts of the operation are being performed, we can identify the amount of time to the total length of the case. The data, therefore, becomes objective and actionable.
(Page 15, lines 297-304).

Comment 2: Despite the discussion on the videos, it was unclear how each video was

made and who decided which steps of the video to highlight. The lack of standardization makes it difficult to reproduce the results in other institutions.

Reply 2: Thank you for your critical review of the manuscript. We have added more detail on how the videos were made.

Changes in the manuscript:
Methods

We developed a novel video-based education curriculum to improve surgical training in the thoracic surgery service. We obtained informed consent from each patient to obtain permission to record the operation for teaching purposes. We recorded the procedure using the integrated video system in the operating room (Karl-Storz, Tuttlingen, Germany) and uploaded it to a secure hospital server. We removed patient identification information and edited the video on desktop software (Camtasia, TechSmith, Okemos, Michigan, United States). The video was edited to play at four times the speed of the live operation and included narration highlighting the operation's important aspects. This was performed by the one surgeon with input from his partners. Each surgeon in the group performs the indicated surgery in largely the same manner, making the steps of the video applicable for residents performing the surgery with any of the attending surgeons. (page 7, lines 115-125)

Comment 3: The manuscript contains many grammatical errors and phrasing that are not consistent with scientific writing. Sentences like" That the surgeon performs allows control of the quality of content that the resident sees…" need to be rewritten. In the discussion section, starting a paragraph with the sentence "There was some discussion about the content of the video" is overly casual, and poorly reflect the content of the discussion.

Reply 3: Thank you for your comments. We have thoroughly reviewed the manuscript for grammatical and typographical errors and made numerous edits. We have also edited the beginning of the discussion section.

Changes in manuscript: Throughout the manuscript.

Reviewer B

Thank you to the authors for their submission and opportunity to review their academic work in the domain of thoracic surgical education.

Your study addresses a key, relevant topic which is the inclusion of multi-modality educational tools to support the continuous learning in training and onwards into the

practice. Video-based learning is of high importance because of high visual fidelity between the video and an operation to be performed, especially if it mirrors the techniques of the surgeons the residents are training with. Alternatively, later in training, it may be advantageous to broaden the portfolio of learning techniques by purposefully viewing videos different from the techniques of the program's faculty.

A few questions:
Comment 1: How did you define "often" in your survey (referring to the comment in line 43 in abstract)?

Reply 1: We used it as a Likert scale as: always, often, sometimes and rarely. Thus, it is defined as 50-75% of the time. We have updated this in the methods.

Changes in the manuscript:
Use of the video: How often did you watch the video before surgery? (always, often, sometimes, rarely) (page 8, lines 144-145).

Comment 2: In line 66 you discuss laparoscopic cases. Consideration should be given to broadening the discussion to thoracoscopic, as the cases you describe in this study are thoracoscopic as well. The precedent is for thoracoscopic and laparoscopic being a part of a video-based education system.

Reply 2: Thank you for critical review of the manuscript. We have added "thoracoscopic."

Changes in manuscript:
Video-based learning has come a long way, from trainees recording their videos for personal feedback training to overhead operating room camera recordings, thoracoscopic and laparoscopic case videos. (Page 5, lines 73-75).

Comment 3: The hypothesis states that having videos of standard operations performed by a surgeon would help residents better prepare for the operation. Your study method was focused on a survey.

Was consideration given to performing a survey at the start of the study period for the residents in the study group to understand their learning habits with regard to video-based learning? For example, what percentage currently uses video as part of a preparatory curriculum before an operation, and where do they source the videos from?

Reply 3. Thank you for your insightful comments. We did not perform a survey at the start of the study. That would have helped understand the learning habits of the residents.

Changes in the manuscript: None.

Comment 4. Why did you not have the residents perform the survey at the end of the rotation to lessen the impact of issues with long-term self-reported data?

Reply 4: Thank you for your comment. We did not have the residents perform the survey at the end of the rotation due to the concern that the residents might not be honest with their answers since they could be very easily identified based on their answers. We felt that honest anonymous answer is better than recall bias introduced by answering the questions at the end of the year.

Changes in the manuscript: None.

Comment 5: Did you use any metrics from Vimeo to validate the self-reported data; if the data is available? For example, # of views over a time frame correlated with the study period.

Reply 5: Thank you for your critical evaluation of the manuscript. Vimeo validated that residents did watch the video. They spent about 16 hours per month viewing about 37 videos during the month.

Changes in the manuscript :

On average, 37 videos were viewed during the month, with residents spending 16 hours per month viewing the videos. (page 11, lines 196-197).

Comment 6: Video-based questions:
Was the resident able to slow down the videos if desired? You mention that the videos were full-length but edited to 4 x natural speed.

Reply 6: Yes. Residents were able to slow down the video.

Changes in the manuscript:
The learner was also able to slow down the video on numerous platforms. (page 8, lines 127-128).

Comment 7: Who performed the narration? Was the narration validated if not the operating surgeon?

Reply 7: The narration was performed by the operating surgeon.

Changes in the manuscript:

The video was edited to play at four times the speed of the live operation and included narration highlighting the operation's important aspects. This was performed by the one surgeon with input from his partners. Each surgeon in the group performs the

indicated surgery in largely the same manner, making the steps of the video applicable for residents performing the surgery with any of the attending surgeons. (page 7, 120 – 125).
Comment 8: Similarly, was the description of anatomy and tips and tricks of the operation validated if not the operating surgeon?

Reply 8: The description of anatomy and tips and tricks of the operation was performed by the operating surgeon.

Changes in the manuscript:

The video was edited to play at four times the speed of the live operation and included narration highlighting the operation's important aspects. This was performed by the one surgeon with input from his partners. Each surgeon in the group performs the indicated surgery in largely the same manner, making the steps of the video applicable for residents performing the surgery with any of the attending surgeons. (page 7, 120 – 125).

Comment 9: If any residents participated in narrating or producing the videos, were those participating residents withheld from analysis (or at least separated into their own group), in order to distinguish the benefit of actively producing the videos vs. more passively watching the videos?

Reply 9: None of the residents participated in narrating or producing the video.

Changes in the manuscript: None.

Comment 10. Was the entire set of videos available at the start of the study ensuring uniform access to the video-based library data set for all participants?

Reply 10: The videos were available to the residents depending on the scheduled surgeries for the upcoming week. Each week the resident received the curated selection of video for the following week to make it easy for the resident to find the video.

Changes in the manuscript:
We placed the video on an online server, Vimeo (Vimeo, LLC, New York, NY, United States), allowing the learner to watch HD videos on numerous platforms. The learner was also able to slow down the video on numerous platforms. (page 8, lines 126-129).

Comment 11. Push-reminder system questions:
What day and time of the week was the email sent, and was it consistent? This question references the predictability of the process influencing participation in the viewing of the videos.

Reply 11. Thank you for your excellent thoughts. The email was routinely sent on Friday afternoon with the videos for the upcoming week to allow residents to review them in preparation.
Changes in the manuscript:
An e-mail link was sent Friday afternoon before the week with similar cases that were going to be performed the following week. (page 8, lines 128-129).

Comment 12. The authors reference a "personal discussion with the learner". Who led this conversation and how often was it done? Also, was that applied to all learners in a systematic way?

Reply 12. The discussion with the learner was conducted by the attending surgeon as part of the orientation at the beginning of the month as well as at the beginning of each cases to gauge their engagement and preparation with the case and it was performed routinely.

Changes in the manuscript:
The attending surgeon explained the availability of the video during the orientation at the beginning of the month and at the beginning of the case to gauge the engagement and preparation of the resident for case. (page 8, lines 129-132).

Comment 13. Survey questions:
Were the answers to the survey questions binary "yes/no" or Likert scale? In the abstract, the authors mention that "90% of residents often or always watched the video" implying a Likert scale.

Reply 13. The question for the "how often did you watch the video before the surgery" was Likert scale and rest were yes/no. We have added this in the methods.

Changes in the manuscript:
Use of the video: How often did you watch the video before surgery? (always, often, sometimes, rarely)
Impact of the video:

1. Did the videos help you prepare for the surgery? (yes, no)
2. Did the videos help you improve your understanding of surgical anatomy? (yes, no)
3. Did the videos help you improve your understanding of the cognitive aspects of the operation? (yes, no)
4. Did the videos help you improve your understanding of the technical aspects of the operations? (yes, no)
5. Did the videos help you better prepare for the operation compared to reading a book? (yes, no)

Evaluation of the content:

1. Was the video of the entire operation helpful in preparing for the operation? (yes, no)
2. Was the narration helpful in preparing for the operation? (yes, no)
3. Would a shorter video with major parts of the operation be helpful? (yes, no)

Access to the video:

1. Did the weekly e-mail with a link to the content encourage you to watch the video? (yes, no)
2. Did the attending asking you if you watched the video encourage you to watch it prior to the operation? (yes, no)

(Page 8-9, lines 144-164)

Comment 14. Could the attending encouraging the residents to watch the video be viewed as an influence to view the videos and introduce bias into the assessment process?

Reply 14. Thank you for your excellent points. It could introduce a bias by the learner to answer the survey in favor of the attending, however, we performed the survey at the end of the year to eliminate such bias. The survey was anonymous where it was not possible to determine which resident answer the survey. Thus, attending encouragement would unlikely influence the resident's survey answer.

Changes in the manuscript: None.

Comment 15 Results:
How does the distribution of PGY level that completed the survey relate to the distribution of PGY level of the 24 residents that were on the service? Was one PGY group more likely to complete the survey over others?

Reply 15. Thank you for your interesting question. We did not observe a difference in the likelihood of survey completion stratified by PGY level.

Changes in the manuscript: None.

Thank you for this submission and opportunity to review. I look forward to reviewing the revisions.

Reviewer C

Comment 1: The title only covers the technical aspects of the curriculum. Why?

Reply 1: Thank you for your insightful question. We have changed the title among many extensive changes to reflect our use of console participation time as our primary outcome measure.

Changes in the manuscript:
Video-Based Curriculum Improves Resident Participation During Robot-Assisted Surgery (page 1, line 2).

Comment 2: The title gives hints that there might be a control group. So there is no. The statement of PREPARDNESS is true but not proofed.

Reply 2: Thank you for your critical review of the manuscript. We agree that the earlier version of the manuscript lacked control group in advantage of surgical video. We have undertaken extensive revisions to provide more objective outcome measures. Rather than the subjective assessment measure of how useful the resident felt that the video was, we are now assessing the amount of console time as a metric of learner preparedness. We show that on average, the residents who had a video-based curriculum had control of the robot 48% compared to 11% who did not have the video-based curriculum.

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We made changes in the title, abstract, methods, results and discussion.

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Analysis of the resident console time of the first robot-assisted hiatal hernia repair of the month showed a significant increase in the amount of time the resident participated in the case from 11% to 48% ($p<0.001$). (page 3, lines 50-52)
Video-based curriculum significantly increases resident participation during robot-assisted thoracic surgery. (page 4, lines 55-56)
Methods:
Next, we hypothesized that the video-based curriculum would increase the resident's participation in the operating room. We used the My Intuitive app (Intuitive Surgical, Sunnyvale, CA, USA, Figure 1) that provides information on the amount of time a person in each of the surgical consoles is controlling the robot. We assessed the time the resident had control of the robot for their first robot-assisted hiatal hernia repair of the rotation with a dual console, assessing the time periods 13 months before and after implementing the curriculum. We measured the amount of time the attending and resident had control of the robot (Figure 2). We divided it by the total time that the

robot was being used in the case to derive the % of the time that the attending and the resident were each using the robot. We obtained the average % of the time before and after the video-based curriculum that the resident was using the robot. We performed a t-test to determine if there was a significant difference between the groups. $P<0.05$ was considered a significant value. (page 10, lines 172-182).

Results:

The most common operation was a robot-assisted hiatal hernia repair with fundoplication. We analyzed the resident console time of the month's first robot-assisted hiatal hernia repair. All of the residents who performed the first robot-assisted hiatal hernia repair were chief residents. During the 13 months before implementing the video-based curriculum, the residents spent on average 11% of the time controlling the robot during the case. After the implementation of the program, the resident spent significantly more time controlling the robot (48%, $p<0.001$, Figure 3) (page 11-12, lines 215-220).

Conclusions:

Our study is unique in that we can objectively quantify the trainee's participation during an operation. Up to this point, participation has been gauged by subjective questionnaires from the learner or instructor asking about autonomy and parts of the surgery performed by the trainee. While this can still be useful, there is a lot of variability in definitions of autonomy, and therefore there is a gap in objective data. With the My Intuitive App, there is greater transparency and quantifiable data regarding trainee participation. While at this point, we are not using the data to identify what parts of the operation are being performed, we can identify the amount of time to the total length of the case. The data, therefore, becomes objective and actionable.
(Page 15, lines 297-304).

Comment 3: Please explain all abbreviations in the text. Some are missing and so not clear for the readers.

Reply 3: Thank you for your critical review. We have clarified all abbreviations in the manuscript.

Changes in the manuscript: We clarified the abbreviations.

Comment 4. Please explain the PGY levels and system to non-US readers.

Reply 4. Thank you for your excellent suggestion. PGY means post graduate year after medical school. PGY-1 is first year after medical school etc. Typically, for general surgery training is 5 years in the US system. After completion of PGY-5 year, the resident qualified to work independently and eligible to take the surgical board certification.

Changes in the manuscript: None.

Comment 4: It is not explained what the question on cognitive aspects is targeted on.

Please make this clear and explain the technical aspects as well.

Reply 4: Thank you for your review of the manuscript. We have edited the manuscript so that console time is now the primary outcome measure, which can be more objectively quantified. This provides the objective assessment of preparation of the technical aspect of the operation. The cognitive aspect was a subjective measure for the learning in understanding the anatomy and how the operation is helping to treat the surgical disease and improve the patient's clinical outcome. Unfortunately, we did not define it for the learner and asked them if they felt that the video helped them improve the cognitive aspect of the operation.

Changes in the manuscript: None.

Comment 5. The hypothesis (75-77) is not understandable. Please find a clearer, better formulation that is more precise.

Reply 5: Thank you for your critical review. We added additional hypothesis looking at an objective measure to better assess the impact of the program.

Changes in the manuscript:

In addition, with the advent of video-based learning and dual console robot technology, we hypothesized that residents with access to a similar case video before the operation would increase their participation in the case. We tested this hypothesis by assessing the time the resident was participating in the operation on the second console before and after implementing the video-based curriculum. (pages 6-7, lines 101-105).

Comment 6. The introduction covers no content or aspects of psychomental training in surgery nor autogenic trainings. Benefits in education and health care were not fully mentioned

Reply 6. Thank you for your critical assessment of the manuscript. We decided to focus on the subjective and objective impact of the video based curriculum for the learner instead of focusing on psychomental training or autogenic training.

Changes in the manuscript: None.

Comment 7. The comparison to "reading a book" seems superficial. Strictly speaking, a repertoire of books should have been available for the participants as an alternative to the videos.

Reply 7: Thank you for your critical comment. Learners have extensive resources available to them including books and electronic resources as part of their training. Video-based curriculum was first introduced for the learning on thoracic surgery

rotation.

Changes in the manuscript: None.
Comment 8. Overall low case number n=24

Reply 8: We agree that there are low number of residents in the study. We have added this in the limitation section.

Changes in the manuscript: In addition, there were only 24 residents in the study. (page 16 lines 313-314).

Comment 9. Only subjective parameters, no control group, so no significance that the training is in favor over classic training

Reply 9: Thank you for your comment. We have edited the manuscript and added objective data with control group.

Changes in the manuscript:
We made changes in the title, abstract, methods, results and discussion.

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a t-test to determine if there was a significant difference between the groups. $P<0.05$ was considered a significant value. (page 10, lines 172-182).

Results:

The most common operation was a robot-assisted hiatal hernia repair with fundoplication. We analyzed the resident console time of the month's first robot-assisted hiatal hernia repair. All of the residents who performed the first robot-assisted hiatal hernia repair were chief residents. During the 13 months before implementing the video-based curriculum, the residents spent on average 11% of the time controlling the robot during the case. After the implementation of the program, the resident spent significantly more time controlling the robot (48%, $p<0.001$, Figure 3) (page 11-12, lines 215-220).

Conclusions:

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(Page 15, lines 297-304).

Comment 10: Impact on OR performance (OR time parameters) or outcome (complication rate) is not described or missing.

Reply 10: Thank you for your insightful suggestion. We have not looked at OR time or complication rates as part of this study. We would be happy to look at this in the future with control group.

Changes in the manuscript: None.

Comment 11: (row 148-149) The participation on filling out the questionnaire was good. However, the rate of watching the videos is low with 40% to 50%. I cannot see a real participation nor identification of the residents with the project.

Reply 11: Thank you for your comments. The question was Likert scale which shows that 40% of the residents watch the video (75-100%) of the time prior to surgery and 50% of the residents watched the video (50-75%) of the time before the surgery. In order to quantify the exact amount of time the residents watched the video, we assess the vimeo data and found that on average 37 videos were viewed during the month with residents spending total of 16 hours per month watching the video. We have added this to the results.

Changes in the manuscript:
On average, 37 videos were viewed during the month, with residents spending 16 hours per month viewing the videos. (page 11, lines 196-197)
Comment 12: There should be a better discrimination between the various operations and there usage. Which of the videos has been watched more than the other? And why? Regarding this a figure might be interesting to show.

Reply 12: Thank you for your critical review of the manuscript. Overall, the most common operation that performed during the year was robot assisted hiatal hernia repair. The most common video that was viewed by resident was robot assisted hiatal hernia repair.

Changes in the manuscript: The most common operation and video watched was a robot-assisted hiatal hernia repair with fundoplication. (page 11, lines 215-216).

Comment 13
- Figure 1 is unnecessary; this content should be described in the text.
- Figure 2 is worthless
- Figure 3 is nearly worthless

Reply 13: Thank you for your constructive comments. We have removed all three figures.

Changes in the manuscript: Figures were removed.

Reviewer D

Kim et al. in their manuscript entitled" Video-Based Curriculum Prepares Residents for Technical Aspect of Thoracic Surgery" present an interesting and well-done comprehensive work.

I have some comments:
The learning curve, transfer of knowledge, and patient outcome are important, and many readers would seek that. I would suggest adding

Comment 1: Are the procedures standardized and performed by one or two experts in the field? Surgeons with time develop their own method of performing an operation and that might affect the learning of a procedure and the outcome. For example, VATS lobectomy or segmentectomy is performed differently, one uses uniportal, and the other anterior approach. Were the procedures in your department standardized? Maybe you could mention it in the paper.

Reply 1: Thank you for your insightful comment. We have added more detail on how the videos were made and how the decision-making process was undertaken. All videos were created by a single surgeon (MPK) with input from the other thoracic surgeons in the group (EYC and RKC). Each surgeon performs the indicated surgery in largely the same manner, making the video standardized to our group's practice.

Changes in the manuscript:

The video was edited to play at four times the speed of the live operation and included narration highlighting the operation's important aspects. This was performed by the one surgeon with input from his partners. Each surgeon in the group performs the indicated surgery in largely the same manner, making the steps of the video applicable for residents performing the surgery with any of the attending surgeons. (page 7, lines 120-125).

Comment 2. The residents and trainees found the videos very useful, however, the outcome of operative performances is most important. Have you seen any progress in the residents/trainees' operational technique? What about the transfer of knowledge from the videos to real-life operations? Many readers would seek if the trainees performed better. This will add additional value to readers.
In the paper, it's unclear if the trainees performed the procedure after seeing the video. It would be great to mention that as well.

Reply 2: Thank you for your thoughtful suggestion. We made extensive edits to the manuscript including changing the primary outcome measure to the amount of time that the resident participates in the operation, which can be interpreted as a measure that they were better prepared for the OR and were able to handle more responsibility during the operations.

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