

## RESEARCH ARTICLE

# Guiding Observers in Trauma Simulation Education: The Effect of Directed Simulation Observation on Achieving Educational Objectives

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## ABSTRACT

**Introduction:** It is known that medical education can be augmented by simulation, that active participant, and observers demonstrate educational benefit. What is not well researched are strategies for maximizing observer benefit. Human patient simulation is of growing importance in the era of restricted duty hours, but remains a limited resource, restricting the number of learners that can be trained at one time. We hypothesized that a strategy could be employed to increase capacity through structured engagement of observers. The purpose of this study is to assess the effects of structured observation tools on observers' confidence in content knowledge, task, and procedural skills, and team-based learning.

**Materials and Methods:** A scenario-based simulation course was created and implemented for third-year medical students during their trauma clerkship. Students participated in simulations and observed classmates via a live video stream. One treatment group of observers used a checklist listing critical actions to guide their observation while the control group had no observational aid. Confidence in ability was measured via pre and post-course self-assessments to identify disparities between the groups. The difference in the reported confidence prior to and following the course was analyzed, primarily using t-tests.

**Results:** Overall, students had a significant increase in self-reported competence following the simulation course ( $p$ -value  $<0.001$ ). Students using the checklist had a greater increase in confidence in competencies involving medical content knowledge

and procedural skills ( $p <0.05$ ), whereas their counterparts who did not have an observation tool had greater confidence increases in team-based competencies ( $p <0.05$ ). Specifically, learners' confidence in their ability to "communicate clearly with team members" increased more in the group without a checklist ( $p <0.05$ ).

**Conclusion:** These findings suggest structured tools directed to the observer impact learning. Checklist observation tools enhanced content knowledge and procedural skill educational objectives, while unaided observation was superior for communication and interpersonal team-based competencies.

**Keywords:** Checklist, High fidelity simulation training, Patient simulation, Simulation, Simulation training, Trauma.

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## INTRODUCTION

It is known that medical education can be augmented by simulation and human-patient simulation has been established as an effective tool in educating medical teams in content knowledge, procedural skills, and team-based competencies.<sup>1–3</sup> Simulation can expose learners to realistic situations, which require clinical acumen and procedural dexterity to be rapidly implemented while working as a team. These characteristics have been shown to make simulation especially applicable to medical education.<sup>4,5</sup> It has become common for a simulation component to be used to augment medical education for students at all levels, even though direct patient care remains the cornerstone of educating learners in the practice of acute care.<sup>6,7</sup> However, medical education has been significantly altered with the addition of restricted duty hours, decreasing the opportunity for learners to benefit from direct patient care.<sup>8–10</sup> Educators may rely on more heavily on additional learning modalities to assure those learners are exposed to the content necessary to face the array of clinical presentations seen in practice.<sup>11,12</sup> Given the proven success of simulation, it has become a frequently chosen modality.<sup>13</sup>

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As simulation becomes more accepted, demand for resources increases. To maximize access, it is often necessary to rotate learners participating in the hands-on simulation, while others observe the simulation directly or via live video stream, and subsequently participate in the debriefing. This method is beneficial for the participants as it allows them to receive feedback not only from the instructor but also from their peers observing the simulation.<sup>14</sup> The value of observation has been established in research showing that observers have comparable educational improvement simulation participants.<sup>15</sup> However, the mechanisms of this learning, and the factors that influence this learning are not well studied in medical simulation literature.

Checklists have become widely used in the acute care clinical environment to address the growing complexity of care and the wide diversity of injuries and technologies. They are used as a tool to assure critical actions and behaviors are completed.<sup>16-18</sup> Checklists have been primarily used as tools for care providers, but delineated lists of critical actions may enhance observer learning in simulation. By focusing on critical actions and behaviors, a checklist could enhance observers' ability to recognize and better understand the key competencies needed to address each patient presentation.

We hypothesized that having observers use a list-based observation tool of the critical actions would further enrich their education and result in higher self-confidence in three core areas of competency: content knowledge, procedural skills, and team-based competencies.

## **MATERIALS AND METHODS**

To test the hypothesis, a simulation course was developed for University of Maryland third-year medical students to complete during their trauma rotation. This study received an exemption from the University of Maryland Internal Review Board. A group of six simulated trauma scenarios was written to emphasize core acute care content knowledge, procedural skills, and team-based competencies. A team of two to three third-year medical students treated the simulated patient while two other teams observed the scenario through live video streaming. Each session lasted two hours and included three distinct simulation scenarios with each team of students participating in one scenario and then rotating to watch the video stream of the other two teams participate in two different scenarios. Each scenario had a list of predefined critical actions and behaviors deemed by an ICU attending physician as the appropriate interventions necessary to stabilize the patient. Sessions were conducted bimonthly and alternated between study groups and control groups.

Prior to beginning the scenarios, the students were oriented to the capabilities of the simulation mannequin (Laerdal model Sim Man human-patient simulator) and the simulated trauma bay in which the scenarios would take place. Additionally, they were instructed to fill out a pre-course confidence assessment survey that addressed the content knowledge, procedural skills, and team-based competencies needed for successful completion of the simulated scenarios (Appendix 1). The simulated scenarios began with a team entering the simulated trauma bay and being given an EMS report on the patient's condition from an EMS provider proxy. During the scenario the learners were provided with a nurse actor to assist them and they were able to call other specialties for consultation but not given any further information on the patient or guidance regarding appropriate interventions. Scenario topics included a patient with a gunshot wound to the thigh, a stab to the back, a splenic rupture from a motor vehicle collision (MVC), a pneumothorax from a MVC, a facial laceration, and an epidural hematoma. Of note, each scenario was equally represented in both study arms.

We tested our hypothesis by separating participants into either a study group in which observers used a checklist of critical actions, or a control group. In the control group, those observing the live video stream were instructed to watch the scenario but were unaided by further instruction or a task to complete while watching the team participating in the simulation. Conversely in the study group "(checklist group)", observers were given an observation tool that listed the appropriate content knowledge, procedural skills, and team-based competencies that was needed to be completed to successfully treat the patient (Appendix 2). They were asked to keep track of the progress made by the team participating in the simulation on the critical action list.

Upon completion of the scenario, a faculty member debriefed the participants, along with the observers. The faculty member reviewed the scenario with the group and led the discussion regarding the appropriate interventions for that particular scenario and the team's overall performance in content knowledge, procedural skills, and team-based competencies. During a session, each learner observed two simulated scenarios, participated in one scenario, and participated in all three scenario debriefings.

At the conclusion of the session, all learners completed the same confidence survey that they were given prior to the course. The students ranked their confidence in their understanding of the medical content covered, ability to perform key actions, and act in certain emergency team roles on a seven-point interval scale (Appendix 1).

### Statistical Analysis

To compare the groups, data were analyzed from a critical action and behavior self-assessment administered before and after the simulation course. The difference in the reported confidence prior to and following the course was analyzed. Results from these measures were analyzed primarily using t-tests to compare the checklist group with the control group. An alpha level of  $p < 0.05$  was considered significant. Microsoft Excel was used for the performance of t-tests.

### RESULTS

Testing lasted six months with a total of 64 students. 30 students were in the control group and 34 students were in the checklist group. Due to anonymity requirements for this study involving medical students, demographic data was not collected.

To judge the overall effectiveness of emergency simulation as a part of the curriculum, students' change in confidence was assessed. The data show that all learners had a significant improvement in their confidence in understanding the content, performing the skills, and acting in the emergency team roles taught in the session. Their average response changed from a 3.95 prior to the class to 5.00 afterwards ( $p$ -value  $< 0.001$ ) (Table 1). Improvement was significant for all questions assessed, for both the experimental ( $p < 0.0001$ ) and control groups ( $p < 0.0001$ ).

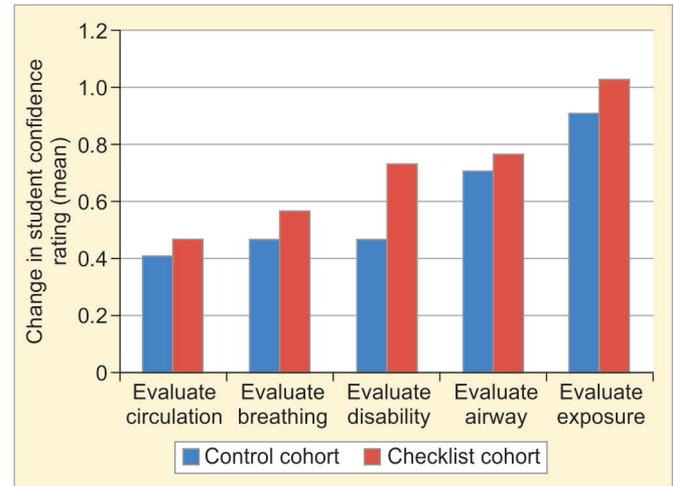
**Table 1 :** Paired samples statistics

	Mean	N	Std. devi	Std. Er mean
Precourse average response	3.95	64	0.681	0.08510
Postcourse average response	5.00	64	0.687	0.08589
Significance (2-tailed t)	$< 0.001$			

We assessed the difference in confidence reported between the study and control cohorts for each survey question. The overall mean did not show a statistically significant difference in the self-reported competencies between the study and control cohorts. However, there were significant differences between the cohorts when considering content knowledge, procedural skill, and team-based questions separately.

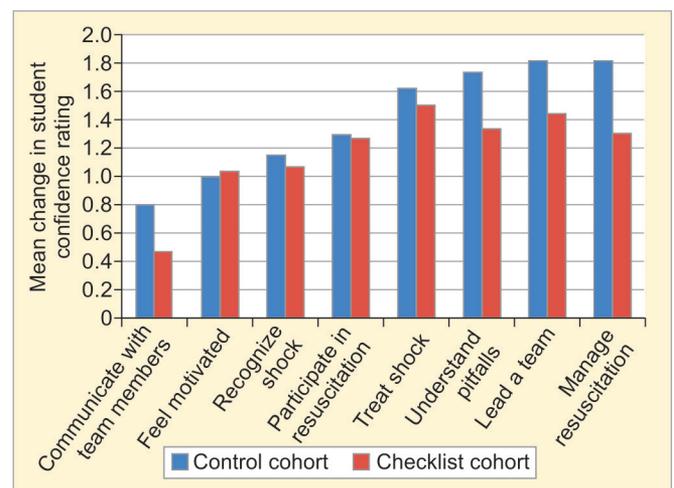
For the knowledge and procedural skill competencies surveyed, the increased confidence from a checklist learners for each item individually was not statistically significant. However, examining the trend of results reveals a significant pattern of differences. The checklist group had consistently greater increases in confidence than the control group in five of the five

categories, representing a statistically significant pattern of results (binomial distribution, sign test  $p < 0.05$ ) (Graph 1).



**Graph 1:** Knowledge and procedural skill reported competencies

The opposite trend was found regarding the confidence in the team-based principals set. For seven of the eight items in this set of abstract principals, the control group had a larger increase in confidence than the checklist group, representing a significant pattern of results (binomial distribution, sign test  $p < 0.05$ ) (Graph 2). Additionally, for the individual item, "communicate clearly with team members," there was a statistically significant ( $p < 0.05$ ) difference in the absolute value of the control groups' confidence compared to the checklist group (Appendix 1).



**Graph 2:** Team based skill reported competencies

### DISCUSSION

Based on our findings, we conclude that directing learners to specific actions representative of a functioning team with a checklist limits their ability to have improved confidence in the broader elements of teamwork.

This may be explained by learners' finite capacity for observation, which is consumed by the specific aspects of performance noted on the checklist. The checklist is thereby preventing observation of, and learning from, the less tangible generalized principles of teamwork. This conclusion is specifically supported by the unaided observer group's statistically significant greater increase in their confidence in "communicating clearly with team members." Conversely, directing the observers' attention to particular procedural skills or content knowledge improves their confidence in these more concrete aspects of patient care.

More broadly, this study shows that participant observers should be considered active learners in simulation activities. As simulation educators, we can influence their learning through interventions such as the observation tool employed in the current study. Based on our data, checklists could be used to amplify the power of task-training simulation. Our results also suggest that task-based checklists should likely be avoided in team-based competency training simulations. However, further study is needed to understand the effects of the content of observer tools on educational outcomes.

This study supports the growing evidence showing simulation's effectiveness and value. The power of simulation education in emergency care extends beyond developing individual strength in content knowledge and procedural skills by improving efficiency, accuracy, and consistency in teamwork while maximizing the strengths of each of the team's members.<sup>19</sup> While nothing can replace the experience of direct patient care, simulation can teach students how to better define the roles and responsibilities of all team members and allow students to better understand the correlation between specific interventions and patient outcomes.<sup>20,21</sup> In the field of emergency care, superb teamwork, and communication translate to improved patient outcomes and for this reason this study's inquiry into an ideal application of simulation of medical education is warranted.<sup>22</sup>

Beyond the message of simulation's effectiveness, this study presents evidence of the educational impact of interventions on those observing simulations. While directed observation of the simulation with checklists did not result in a greater increase in all three areas of competency (content knowledge, procedural skills and team-based) as a whole, the effect it had on the three competencies individually provides insight into optimal simulation teaching practices.

This study's findings should be interpreted with an appropriate level of caution. This study was purposefully designed to measure changes in student's reported self-confidence in the three learning categories instead of trying to measure changes through an objective content

knowledge exam or procedural test. This methodological design was used to allow statistical comparison of scores between the three different categories of learning, while avoiding the biases introduced by repeated testing or pre-test exposure scenarios. Using the same Likert scale scores between all three types of learning allowed each to be compared directly. Measures such as a content knowledge test, a proctored procedural skills test, or rater graded teamwork assessment to more objectively measure participants prior to and after the course would have exposed the participants to scenario details before completing the course. This would have affected their performance and their engagement as an observer leading to multiple additional confounders.

Studies show that self-confidence, in general, correlates poorly with significant increases in clinical competency or objective testing.<sup>23,24</sup> Therefore, further investigations into directed observation tools' effect on content knowledge, procedural skills, and team-based competencies with competency-based assessments are needed to substantiate this study's findings.

## CONCLUSION

Using observational tools for observers-participants in simulation to influence educational goals represents a novel approach to simulation training. Our data suggests checklist-based observer learning is superior for teaching content knowledge and procedural skills, while unaided observation may be preferred for improving communication and interpersonal team-based competencies. As simulation becomes more widely practiced, the use of checklist-based observation may become a key component in maximizing simulation resources to increase learning in the era of restricted duty hours.

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**INVITED COMMENTARY**

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Medical educational simulation has been an essential element in the formation of health care professionals. In the development of simulation programs, it is imperative to understand the knowledge and skill required by the students for an adequate learning process and experience. Successful simulation programs should be designed using realistic concepts and models with the students achieving the expected competency in a stimulating academic environment.<sup>1</sup>

Particularly, surgical simulation has greatly expanded to be one of the main tools required by residency accreditation organizations for educational training. It has been proven to enhance preparation and patient safety by promoting proficiency and confidence. The *Journal of Surgical Simulation*, an international peer-reviewed journal, has even been established as an informational exchange venue for this rapidly expanding field.

Currently, graduate medical education departments have to deal with the dilemma of dealing with the restrictions in duty hours and appropriate training of residents and fellows. Simulation labs are emerging throughout the nation's educational departments creating financial constraints for these institutions in acquiring the proper teaching resources. Not only for surgical training, but it is also now rapidly expanding as a training tool for other health-related professionals (EMS, nurses, respiratory therapists, flight nurses, etc.). There are four vital components to take into consideration in the development of educational simulation programs: (1) adequate teaching and education, (2) proper assessment and evaluation, (3) system integration and improvement and (4) research. A post course meeting between the faculty and the students stimulates and reinforces the objectives of the training scenario and fully addresses any doubts about specific issues produced during the exercise; therefore, improving the familiarity of the students to their newly acquired knowledge and skills.<sup>1</sup>

The authors are presenting a well-structured study on the benefits of designed simulation scenarios and their effect on learning at the individual and team level. This manuscript shows reliable and concrete results based on the design and length of the study. Standardized checklists, pre-and post-test evaluations, supervision by experienced attending physicians and peer observational processes are the techniques to apply in simulation training courses. Although, the checklist was not found to be statistically significant in improving skills at the teamwork level, it certainly is an excellent method to standardize the several scenarios and practices required by the testing group. I agree that further developments are necessary to improve the learning experience capacity in the competencies and practices at the teamwork level. There have been previous studies supporting the use of scenario-specific targeted behavioral markers to enhance the reliability and validity of the team performance observational tools for use in the evaluation of team-based simulation scenarios.<sup>2</sup> These are comprehensive techniques that should be considered for enhancing accuracy in the development of forthcoming educational programs. I applaud the efforts of the authors in developing an elegant and well-organized study in a topic which is a vital feature in the advancement of future educational techniques. I encourage them to continue with this vital project.

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**Manual Lorenzo**