THE ASIA-PACIFIC SCHOLAR
MEDICAL AND HEALTH PROFESSIONS EDUCATION

SHORT COMMUNICATIONS

Published online: 2 January, TAPS 2018, 3(1), 42-49
DOI: https://doi.org/10.29060/TAPS.2018-3-1/SC1059

# A study on the usefulness of high fidelity patient simulation in undergraduate medical education

Bikramjit Pal, M. V. Kumar, Htoo Htoo Kyaw Soe, Sudipta Pal

*Melaka Manipal Medical College, Manipal University, Malaysia*

**Abstract**

**Introduction:** Simulation is the imitation of the operation of a real-world process or system over time. Innovative simulation training solutions are now being used to train medical professionals in an attempt to reduce the number of safety concerns that have adverse effects on the patients.

**Objectives:** (a) To determine its usefulness as a teaching or learning tool for management of surgical emergencies, both in the short term and medium term by students' perception. (b) To plan future teaching methodology regarding hi-fidelity simulation based on the study outcomes and re-assessment of the current training modules.

**Methods:** Quasi-experimental time series design with pretest-posttest interventional study. Quantitative data was analysed in terms of Mean, Standard Deviation and standard error of Mean. Statistical tests of significance like Repeated Measure of Analysis of Variance (ANOVA) were used for comparisons. P value < 0.001 was considered to be statistically significant.

**Results:** The students opined that the simulated sessions on high fidelity simulators had encouraged their active participation which was appropriate to their current level of learning. It helped them to think fast and the training sessions resembled a real life situation. The study showed that learning had progressively improved with each session of simulation with corresponding decrease in stress.

**Conclusion:** Implementation of high fidelity simulation based learning in our Institute had been perceived favourably by a large number of students in enhancing their knowledge over time in management of trauma and surgical emergencies.

**Keywords:** *High Fidelity Simulation, Simulation in Medical Education, Stress in Simulation*

## I. INTRODUCTION

High fidelity simulation is an innovative and effective strategy to address increasing student enrolment, faculty shortages, and limited clinical sites (Schoenig, Sittner, & Todd, 2006). The value of simulation in undergraduate medical education is now well established; it basically animates the curriculum. Medical training in the current era is multi-modular and simulation based learning may play a pivotal role in improving training standards in medical schools (Joseph et al., 2015). High Fidelity Patient Simulators replicate patient care scenarios in a realistic environment and have advantage of repetition of the same scenario in a controlled environment which allows practice without risk to patient thereby minimizing chances of medical error and thus, make them a useful tool for student assessment. It is also recognized that putting the learners into a simulated critical care environment subjects them to stresses which have not been well studied. There were many studies on the use of simulation (mainly low and medium fidelity) in medical education but few studies were done on the effectiveness of high fidelity simulation based teaching in under-graduate medical students. The importance of simulation in training medical students are being recognized by academic institutions around the world. In spite of proven benefits, it has so far not been formally introduced as a part of curriculum in medical colleges in our settings. With this background, this study was conducted to explore the perception of medical students on the usefulness of high fidelity patient simulation.

## II. METHODS

This was an ongoing research study about the impact of high fidelity patient simulation in undergraduate medical education. METIman Pre-Hospital High Fidelity Patient Simulator (Serial number: MMP-0418/2013; CAE Healthcare, USA) was used in this study. The final year MBBS students of MMMC were the subjects of this study. The students of these batches who volunteered were recruited during their surgical posting after obtaining their informed consent. The proportion of students who volunteered was 92.73% (204 students out of total number of 220 students).

The simulation sessions were conducted with one sub-group of 12 to 15 students which were further divided into 3 teams of 4 to 5 students. The participants were briefed about the simulation sessions and expected learning outcomes. The duration of each simulation session was 50 minutes: Briefing (10 minutes), Simulation (25 minutes) and Debriefing (15 minutes). A theoretical briefing was given by the investigator on ATLS protocol for trauma management and management of surgical emergencies like hypovolemic shock, tension pneumothorax and head injury. This briefing was done as an interactive lecture to the whole subgroup. Each team then participated in a trauma simulation session and the scenario was chosen randomly from among the conditions mentioned above. The three teams in a subgroup were assigned three different scenarios. The teams were then debriefed in order to achieve the learning outcomes. The same team had participated second time in the simulation of the same scenario after 1 week and third time after 3 - 4 weeks to test their short to medium term retention of knowledge and practical skills, followed by final debriefing. Thus, at the end of the course, each student was expected to perform satisfactorily any of the roles during the management of the standard scenarios.

Each student was assessed individually in terms of their progress in knowledge, confidence and stress reduction. We developed a standardized five point (very poor to excellent) Likert scale questionnaire (Appendix I), to collect initial background knowledge of the students on the first day of the training course in terms of ATLS protocol for management of acute trauma, management of hypovolemic shock, management of tension pneumothorax and management of head injury. The same questionnaire was repeated after every session for post-session knowledge assessment.

Another set of five point Likert scale questionnaire was designed to obtain participant feedback after each session on the relevance and usefulness of the simulation experience, effectiveness of briefing and debriefing and stressor assessment. It was an ordinal scale used by respondents to rate the degree to which they agree or disagree to a statement (Appendix II). The stressor questionnaire contained thirteen items (Appendix III). They resembled pre and post tests for comparison to note progress in confidence and stress reduction. Finally, a third set of questionnaire was administered to the students at the completion of training for their feedback assessment of training course (Appendix IV).

We used Microsoft Excel for data entry and SPSS software (SPSS Inc. Released 2009. PASW Statistics for Windows, Version 18.0. Chicago: SPSS Inc.) for data analysis. We calculated descriptive statistics such as frequency and percentage for categorical data; mean and standard deviation for total score of knowledge, simulation assessment and stressor assessment. We used one-way repeated measure ANOVA to determine the statistically significant difference in simulation assessment (total score) and stressor assessment (total score). We also used Friedman test to determine the statistically significant difference in individual item of knowledge assessment, simulation assessment and stressor assessment. P value <0.001 was taken to be statistically significant in our study.

## III. RESULTS

The cohort of 204 participants in this study were selected from four batches of final year MBBS students (October 2015 to April 2016).

Friedman test of simulation assessment for individual items showed significant difference of simulation assessment over time. One-way repeated measure ANOVA of stressor assessment (total score) revealed statistically significant difference ($p < 0.001$) of total score of stressor assessment over time. Total score of stressor assessment was decreased from 27.09 (Mean) / 7.41(SD) at pre-simulation to 25.63 (Mean) / 8.06(SD) at post-simulation I, to 23.92 (Mean) / 8.92(SD) at post-simulation II and to 23.75 (Mean) / 9.77(SD) at post-simulation III.

For assessment of stress during simulation sessions, we used Likert scale of 1 to 5 (low stress to maximum stress). There was significant difference ($p < 0.001$) of stressor assessment during simulation over time (Friedman test) for following individual items where majority of the students had the opinion of “moderate stress” regarding “Competition with team members”, “Limited time during simulation sessions”, “Participation in debriefing” and “high stress” regarding “Death of simulated patient”.

| Item | Pre | Post I | Post II | Post III | P value |
|---|---|---|---|---|---|
| | Median (Q1, Q3) | | | | |
| 1 – strongly disagree, 2- tend to disagree, 3 – neither agree or disagree, 4 – tend to agree, 5 – strongly agree | | | | | |
| The session level was appropriate to my present level of knowledge and experience | 4.0 (3.0, 4.0) | 4.0 (4.0, 4.0) | 4.0 (4.0, 4.0) | 4.0 (4.0, 4.0) | <0.001 * |
| It encouraged my active participation | 4.0 (4.0, 4.0) | 4.0 (4.0, 5.0) | 4.0 (4.0, 5.0) | 4.0 (4.0, 5.0) | <0.001 * |
| Clinical management more easily learned | 4.0 (4.0, 5.0) | 4.0 (4.0, 5.0) | 4.0 (4.0, 4.0) | 4.0 (4.0, 4.0) | 0.996 |
| The training session resembled a real life situation | 4.0 (4.0, 5.0) | 4.0 (4.0, 5.0) | 4.0 (4.0, 5.0) | 4.0 (4.0, 5.0) | 0.011* |
| It helps me to think quickly | 4.0 (4.0, 5.0) | 4.0 (4.0, 5.0) | 4.0 (4.0, 5.0) | 4.0 (4.0, 5.0) | 0.003* |
| Repetition of the scenario during training is essential | 4.0 (4.0, 5.0) | 4.0 (4.0, 5.0) | 4.0 (4.0, 5.0) | 4.0 (4.0, 5.0) | 0.001* |
| Time for the scenario was adequate | - | 4.0 (3.0, 4.0) | 4.0 (4.0, 4.0) | 4.0 (4.0, 4.0) | 0.149 |
| **Briefing and Debriefing:** | | | | | |
| Time for initial briefing was adequate | 4.0 (4.0, 5.0) | 4.0 (4.0, 4.0) | 4.0 (4.0, 4.0) | 4.0 (4.0, 4.0) | <0.001 * |
| Time for debriefing was adequate | - | 4.0 (3.0, 4.0) | 4.0 (4.0, 4.0) | 4.0 (4.0, 4.0) | 0.184 |
| Debriefing helped me to learn better | - | 4.0 (4.0, 4.0) | 4.0 (4.0, 4.0) | 4.0 (4.0, 4.0) | 0.273 |
| **Affective:** | | | | | |
| I want to have further sessions on the simulator | - | 5.0 (4.0, 5.0) | 4.0 (4.0, 5.0) | 4.0 (4.0, 5.0) | <0.001 * |
| I feel that simulation is essential to train in trauma management | 4.0 (3.0, 5.0) | 5.0 (4.0, 5.0) | 4.0 (4.0, 5.0) | 4.0 (4.0, 5.0) | <0.001 * |
| **Learning Outcomes:** | | | | | |
| I am confident of managing a trauma scenario in real life | - | 3.0 (3.0, 4.0) | 4.0 (3.0, 4.0) | 4.0 (3.0, 4.0) | <0.001 * |

Table 1. Simulation assessment at pre-simulation, post-simulation I, post-simulation II and post-simulation III (individual item)

## IV. DISCUSSION

High fidelity simulators have revolutionised training as almost any emergency situation can be replicated. Simulation sessions have provided opportunity for clinical students to collaborate and apply both cognitive and psychomotor skills. Our main objective was to determine usefulness of high fidelity simulation as a teaching or learning tool for management of surgical emergencies. The study showed that high fidelity simulators had made a difference in enhancing the knowledge over time in management of trauma and surgical emergencies as perceived by our students. It also showed that learning had significantly improved with each session of simulation and learners' attitudes were supportive of simulation. Wayne, Barsuk, O'Leary, Fudala, & McGaghie (2008) showed that internal medicine residents had increased knowledge and skills using simulation technology and deliberate practice. Participants in one study (Okuda et al., 2009) felt simulation based teaching was a reliable tool for

assessing learners by providing good feedback on performance which was similar to our observation. In a study by Founds, Zewe, & Scheuer (2011), participants felt that high fidelity simulators can present simulations that were closer to real life situations which was similar to opinion of most of our students. The study revealed that simulation sessions with high fidelity simulators encouraged active participation of students who need further sessions on simulation for better understanding of clinical problems and knowledge acquisition. The finding in one of the main area of study: "Clinical management more easily learned" was not satisfactorily documented ($p < 0.996$). It showed that simulation did not always help in better understanding of management of clinical problems. The drop in stress was significant at week II and III but flattened out in week IV which might be due to participants' increasing adaptability to simulated atmosphere. The time for briefing was adequate but participants felt that time for debriefing was inadequate and debriefing did not help them to learn better. This was an area of utmost concern to us as we concluded that there was a definite lacuna in our debriefing process. We planned to rectify our shortcomings and deficiencies in this matter. For long term assessment we planned to get these students back during their internship period and do a re-test to validate the improved outcome. Most of the students had a favourable perception about high fidelity patient simulation indicating that it has bright prospect for its inclusion in under-graduate curriculum in near future.

## V. CONCLUSION

Few studies have been done with regards to students' perception on the effectiveness of high fidelity simulators in training under-graduate medical students. This innovative training method may help to improve the quality of medical care and safety of the patient. The limitation of this study: This was a single centre study and participants who volunteered were only recruited. Hence findings may not be applicable to other settings. Even though training with high fidelity simulators was perceived positively by the students, it remained unclear whether the learning skills acquired with this teaching methodology would translate into improved patient care.

## Notes on Contributors

Bikramjit Pal MBBS, DA (Anesthesiology), MS (Surgery); Associate Professor, Department of Surgery and Chairman of Clinical Skills Learning Committee, Member of the International Forum of Teachers of the UNESCO Chair in Bioethics, Melaka-Manipal Medical College, Manipal University, Malaysia

MV Kumar BSc, MBBS, FRCS Ed; Professor and Ex-HOD, Department of Surgery and member of Clinical Skills Learning Committee, Melaka-Manipal Medical College, Manipal University, Malaysia

Htoo Htoo Kyaw Soe MBBS, MPH, PhD; Associate Professor, Department of Community Medicine and member of Statistics Committee, Melaka-Manipal Medical College, Manipal University, Malaysia

Sudipta Pal MBBS, PGDMCH; Lecturer, Department of Community Medicine, Melaka-Manipal Medical College, Manipal University, Malaysia

## Ethical Approval

Duly taken from the IRB & IEC, Melaka-Manipal Medical College.

## Acknowledgements

The final year MBBS students of Melaka-Manipal Medical College who had participated in this research project, the faculty of the Department of Surgery, the lab assistants and technicians of Clinical Skills Lab, the Management of Melaka-Manipal Medical College and last but not the least, Prof. Dinker Pai (Ex-Head of Department of Surgery, MMMC), for his inspiration, initiation and conceptualization of this research project.

## Declaration of Interest

The authors have not received any funding or benefits from industry or elsewhere to conduct this study and have no conflicts of interest.

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*Bikramjit Pal
Associate Professor (Surgery),
Melaka-Manipal Medical College
Jalan Batu Hampar, Bukit Baru,
75150, Melaka, Malaysia.
Mobile: +60-1118728085.
Landline (Office): +60-6-2896662-1116; +60-6-2925849/50/51.
FAX: +60-6-2817977.
E-mail: bikramjit.pal@manipal.edu.my
Alternative email: drbikramjitpal@gmail.com