In situ simulation training for a better interprofessional team performance in transferring critically ill patients with COVID-19: a prospective randomised control trial

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ABSTRACT

Background Transferring critically ill patients with COVID-19 is a challenging task; therefore, well-trained medical team is needed. This study aimed to determine the role of in situ simulation training during pandemic by using high-fidelity manikin to improve interprofessional communication, skills and teamwork in transferring critically ill patients with COVID-19.

Methods This single-blinded randomised control trial included 40 subjects allocated into standard low-fidelity simulator (LFS) and high-fidelity simulator (HFS) groups. Subjects, who were not members of multiprofessional team taking care of patients with COVID-19, in each group were assigned into small groups and joined an online interactive lecture session, two sessions of in-situ simulation and a debriefing session with strict health protocols. The first simulation aimed to teach participants the skills and steps needed. The second simulation aimed to assess transfer skills, communication and teamwork performance, that participants had learnt using a validated, comprehensive assessment tool. Data were analysed using unpaired t test or Mann-Whitney test.

Results The HFS group showed significantly better overall transfer and communication skills than LFS group (89.70±4.65 vs 77.19±3.6, <0.05 and 100 vs 88.34 (63.33–100), p=0.022, respectively). The HFS group also demonstrated significantly better teamwork performance than the standard LFS group (90 (80–900) vs 80 (70–90), p=0.028).

Conclusion In situ simulation training using HFS significantly showed better performance than the standard training using LFS in regards to overall transfer and communication skills as well as teamwork performance. The training using HFS may provide a valuable adjunct to improve interprofessional skills, communication and teamwork performance in transferring critically ill patients with COVID-19.

Trial registration number NCT05113823.

INTRODUCTION

Safe transportation of critically ill patients is challenging. It depends on patient selection, staff training, interprofessional teamwork, predefined hospital transport protocols and checklists, appropriate transport equipment availability and also transport timing.[1–5] Such complex system and situation could be recreated in a simulated environment. Simulation-based learning has proven to have a good impact on the students' competence. An in situ simulation, conducted with multidisciplinary team, could recreate the circumstances similar to which they conduct their usual activities, thus further accelerate the students' knowledge, skills and safety attainment process.[6] High-fidelity simulator (HFS) has also started to be used widely in simulation-based training aside from low-fidelity simulator (LFS). It supports a realistic yet safe environment, where participants can face a rare clinical situation and learn from mistakes without harming the patients.[3 5]

Simulation may play an integral role in the medical education's response to the pandemic era. COVID-19 pandemic created an urgent need for targeted and adaptive training for all intensive care and medical emergency team members, especially in conducting safe intrahospital transportation of critically ill patients with COVID-19. Modifying interprofessional simulation-based training by implementing strict health protocols is necessary to initiate simulation-based training. This implementation enable us to continue improving knowledge, skills, communication and teamwork performance in managing and transferring patients with COVID-19 during pandemic era. This study aimed to determine the role of in situ simulation training by using HFS compared with the standard LFS to improve interprofessional skills, communication and teamwork performance in transferring critically ill patients with COVID-19.

METHODS

This single-blinded randomised control trial aims to study in situ simulation training using HFS compared with a standard use of LFS. The study was held in the High Care Unit Cipto Mangunkusumo Hospital and Simulation-Based Medical Education and Research Center (SIMUBEAR), IMERI Universitas Indonesia. The sample size was determined using a numeric analytical formula to achieve a 80% power with 5% error rate and an estimated drop out of 10%, resulting in 20 subjects in each group. After obtaining ethical approval from the Ethics Committee of the Faculty of Medicine, Universitas Indonesia/Cipto Mangunkusumo Hospital, achieving Clinical Trial approval, 40 subjects,

comprised of 16 medical doctors and 24 nurses, who were in good physical condition, not detected positive from COVID-19 infection and had no history of involving COVID-19 patient care, were voluntarily recruited. All subjects provided informed consent. The study fully implemented the principles outlined in the Declaration of Helsinki and followed the CONSORT checklist (online supplemental file 1online supplemental figure 1)

The simulation-based training consisted of an online interactive lecture session 1 day before simulation, two sessions of in situ simulation and debriefing at the end of each simulation session. Eight scenarios (online supplemental figure 2) were developed to prevent information bias, as the study was spread throughout 3 days. We divided eight groups into 3 days as there was a time limit on the venue. Reading materials of the interactive lecture topic were given to the subjects a day before. Subjects were obliged to complete an online 5-item multiple-choice pretest and post-test for cognitive evaluation.

Specific assessment tool was developed based on focus discussion group, after that it was developed and validated to evaluate interprofessional teamwork, communication and the team's ability to perform each step in the COVID-19 critically ill patient transportation checklist were used. Skills and communication assessment tools were developed from predefined hospital transport protocols and checklists. Interprofessional teamwork was assessed using interprofessional teamwork assessment tools that had been developed in the previous study.[7–11] Each item was rated '0' for undone skill, '2' for a incompletely done skill and '5' for the skill that had been done completely. Validation of the study checklist was performed by measuring Cronbach's alpha by our senior anaesthesiologist consultants (online supplemental figure 3). The panel consisted of five senior anaesthesiologist consultants who were not part of the research team.

Subjects were randomly allocated into two large groups, the HFS and the LFS groups using a random allocator downloaded from wwwrandomizerorg. Each group was divided into smaller groups, consisting of two doctors and three nurses. All subjects joined the same interactive lecture session discussing patient transfer methods during COVID-19 and two sessions of in situ simulation according to their assigned group. Each group was given a 1-hour lecture session and an approximately 2-hour in situ simulation session. In situ simulation and debriefing were performed by implementing appropriate personal protective equipment (PPE) and social distancing. At the end of each simulation session, each group underwent a debriefing session conducted by an experienced instructor.

The first simulation was aimed to teach participants skills and steps in transporting critically ill patients with COVID-19 according to the hospital checklist. Meanwhile, the second simulation was aimed to assess skills, teamwork and communication that participants had learnt from the previous simulation by using the abovementioned assessment tools. In addition to comparing each point in the assessment tool between the two groups, the points earned were added to get the overall points for total skills, cooperation and communication score. At the end of the session, subjects gave feedback immediately online, which provided accountability for attendance, content learning and course evaluation in general.

All collected data were then analysed using SPSS V.26.0. Categorical data are presented in the form of numbers and percentages (n (%)). Numerical data are shown in the form of mean±SD if the data distribution is normal or in the form of the median (minimum–maximum value) if the distribution is not normal. Unpaired t test and Mann-Whitney test were used to analyse the two numerical variables.

Table 1 Subject characteristics

Variables	HFS group (n=20)	LFS group (n=20)
Age (year)	27.5 (23–41)	30 (24–46)
Sex		
Male (n)	4	7
Female (n)	16	13
Working experience (Year)	3.5 (1–13)	8 (0.25–27)
Working unit		
Emergency doctor (n)	8	5
Inpatient unit (n)	4	4
Outpatient unit (n)	4	4
HCU and ICU (n)	4	4

*Value in percentage (%).
†Value in median (minimum–maximum).
HFS, high-fidelity simulator; ICU, Intensive Care Unit; LFS, low-fidelity simulator.

RESULTS

All the participants completed the study. The majority were woman (80% in the HFS group and 65% in the LFS group), and an average of 27.5 years and 30 years old in the HFS and LFS groups, respectively. Participants in the HFS group had median working experience of 3.5 years, and those in the LFS group had 8 years. The participant characteristic details are summarised in table 1.

There was no significant difference in pretest and post-test cognitive scores between the two groups (table 2). Thetable 2 also presents the overall transfer skill, communication skill and teamwork scores. The subsection analysis of the skill components is presented in table 3.

DISCUSSION

Intrahospital transfer of critically ill patients with COVID-19 is challenging and requires proper strategies to maintain patient safety and prevent disease exposure to the medical team. Sixty-eight per cent of critically ill patients could experience unexpected events; and 9% could experience severe unexpected events, including hypotension, airway problems and increased intracranial pressure during transport.[12] In handling critically ill patients with COVID-19, medical teams require skills, communication, good teamwork and sufficient knowledge.

Since the pandemic started, there have been increasing needs in intrahospital transfer of critically ill patients with COVID-19. Two studies reported that 63.4% of transferred patients were confirmed for COVID-19.[13 14] Cautious planning and prudent decision are needed to ensure the safety of the critically

Table 2 Comparison of cognitive, transfer skill, communication skill and teamwork scores between the groups

Variable	HFS group (n=4)	LFS group (n=4)	P
Cognitive			
Pre-test	72.99±11.13	68.99±14.55	0.335*
Post-test	87.67±7.26	86.99±9.79	0.889†
Transfer skills	89.70±4,65	77.19±3,61	0,000†
Communication	100	88.34 (63.33–100)	0, 022†
Team work	90 (80–90)	80 (70–90)	0,028†

*Unpaired t-test; .
†Mann-Whitney test.
.HFS, high-fidelity simulation; LFS, low-fidelity simulation.

Table 3 Distribution of skill components of the two groups

Variable	HFS group (n=4)	LFS group (n=4)	P
Pre-transfer preparation skills			
Equipment preparation and donning	86.54±13.92	77.95±12.49	0.287*
Patient preparation	87.41±7.12	77.78±7.70	0.048*
Medical team preparation	100 (50–100)	100	1.000†
Skills during patient transfer	93.2 (83–98)	85 (83–97)	0.090*
Monitoring of patient and equipment	90 (73.33–90)	76.67 (56.67–90)	0.067*
PPE doffing	85.83±8.01	48.33±23.80	0.010†

*Mann-Whitney test.
†unpaired t-test.
HFS, high-fidelity simulation; LFS, low-fidelity simulation; PPE, personal protective equipment.

ill COVID-19 transferring process. Hence, there are urgent needs for targeted and adaptive training for all intensive care and medical emergency team members conducting intrahospital transportation of critically ill patients with COVID-19.

Doubts about the risk of COVID-19 infection have made many institutions withhold in-hospital training. Modifying interprofessional simulation-based training by implementing strict social distancing and appropriate PPE might be the solution to improve the knowledge, skills, communication and teamwork needed to manage and transfer patients with COVID-19. Additionally, simulation-based training using HFS might allow learners of all levels an opportunity to immerse themselves in a better realism-simulated clinical scenario, suspend their disbelief and engage more in the learning activity. Hence, this highly needed simulation base training can be carried out more effectively.

There were no differences in the baseline age and workplace characteristics between the HFS and LFS groups (table 1). Subjects in the LFS group had longer working experience compared with those in the HFS group. The outcome of the post-test supports the homogeneity of the participants between the groups. After the team training, there was an increase in participants' knowledge in both groups, but there was no significant difference found between both groups. The team-based simulation assessment revealed significant difference in the global skill performance scores (p>0.05) between the HFS (89.70±4.5) and LFS (77.19±3.61) groups. There were also significant differences in the global communication and teamwork performance scores (p=0.022 and p=0.028, respectively) in both groups. Adequate communication and good teamwork are critical to the safe transfer of a critically ill patient. The results are in line with the previous researches that HFS is preferable for skills training, stress exposure training and team training than LFS.[7–11] Training using HFS enhances participants' skills, teamwork and leadership.[9] Obviously, HFS contains features such as realistic physiological responses, the ability to communicate and interact with the manikin and various other feedback mechanisms. Hence, HFS enables low-risk, standardised training with a complex, immersive scenario and realistic feedback.[15–18]

The subject characteristic may also play an essential role in this study. Most of the subjects participating in this training had work experience for 4–7 years. Based on the simulation training given, the participants achieve a different competency levels. A high degree of realism simulation training favours a higher clinical competence in the classical Miller pyramid of clinical competence assessment.

Both HFS and LFS simulations were performed as in situ simulations. The attendee had opportunities to identify hazards and deficiencies in their clinical systems, the environment and know another provider. Patients with COVID-19 are often highly complex Intensive Care Unit (ICU) patients with more than one organ system failure. Pretransfer preparation is needed to ensure patient's physiological stability than patient safety during transfer. Unstable patients and lack of potential events' anticipation during transfer can worsen patient outcomes. Physiological stability during transfer involves careful pretransfer assessment and care and preparation.[19] Troncoso et al stated that approximately 25.4% of critically ill patients with COVID-19 need vasopressor, 13,1% were pharmacologically paralysed and 22% required change of ventilator setting during transfer.[20] Allen et al stated that 45% of patients with COVID-19 needed to be intubated, 40% required additional paralytic drugs and 40% of the patients required to be given vasopressors before transfer.[13] Most patients require oxygen therapy ranging from high-flow nasal cannula, continuous positive airway pressure (CPAP), to mechanical ventilation. The success of transfer critically ill patients with COVID-19 is based on anticipation and prevention of potential complications and hazards to the patient and transfer team.[16]

When inspecting the individual section of the assessment tool, the statistically significant difference between HFS and LFS was noted for item patient preparation but not for equipment preparation, team preparation and donning items (table 3). Preparing patients before a transfer is a more complex procedure than equipment preparation, team preparation and donning. This procedure also requires good clinical reasoning, judgement and communication between team members. HFS was better than LFS in this case. A higher level of fidelity was needed in achieving higher intended learning goals.[21] In the immersive and safe learning environment of HFS, participants can make mistakes, revise those mistakes in real time and learn from them without fear of compromising patient safety. Previous research has also shown that the effect of stress that participants gain from simulation-based high-fidelity training will be appraised as a challenge rather than a threat. This positive reaction will contribute to performance improvement.[22 23]

Interestingly, both groups do not show significant difference in medical team preparation items, including donning items to ensure healthcare provider safety. The participants might have been accustomed to preparing themselves in this pandemic state, including wearingPPE and maintaining a good protocol.[24] Donning items included wearing appropriate masks and other PPE (gloves, fluid-repellent long-sleeved gown and eye protection devices), which were put in order based on the level of precautions required.

There was no significant difference in skill score during the transfer between both groups (table 2). This might be because the task to be fulfilled during transfer was not as difficult and complex as pretransfer preparation. If appropriate and precise measures have been taken pretransfer, there should be little requirement for active intervention during transport. During the transfer, medical teams should continue to reassess the patient's clinical status, ensuring that vascular access sites remain accessible, good teamwork and communication.

After transfer, the HFS group showed a higher result in PPE doffing (table 3). Doffing involves more complex and challenging steps than donning.[25] As mentioned before, HFS is better than LFS in achieving competence in a more complex and difficult task. In line with this result, deviation in doffing protocols was more often found than in donning protocols. Ensuring safe

practices for high-risk, highly potential COVID-19 exposure scenarios in minimising contamination risks requires specific training methods in doffing protocols compliance.

Limitation

Although this study tested the participants' team performances and attitudes using simulation-based assessments and validated tools, the self-reported attitude towards teamwork and collaboration of the attendee and the retention of team performances were not measured. Further studies can be conducted to gain insights into the more effective training methods and the use of the attendee's self-reported attitude in transferring critically ill patients with COVID-19.

CONCLUSION

In situ simulation training improved skills, communication and interprofessional team cooperation in transferring critically ill patients with COVID-19. HFS-based training showed better team performance compared with the standard LFS-based training.

Main messages

- ► In situ simulation training, both using high-fidelity simulator (HFS) and low-fidelity simulator (LFS), improved skills in transferring critically ill patients with COVID-19.
- ► In situ simulation training, both using HFS and LFS, improved communication in transferring critically ill patients with COVID-19.
- ► In situ simulation training, both using HFS and LFS, improved interprofessional team cooperation in transferring critically ill patients with COVID-19.

Current research questions

- ► Will in situ simulation training improve skills of its participants?
- ► Will in situ simulation training improve communication of its participants?
- ► Will in situ simulation training improve interproffesional team cooperation of its participants?

What is already known on the subject

- ► Subjects' Characteristics
- ► Subjects are health professionals that are usually handle hospital patient transfer

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