Clinical Simulation in Nursing (2019) 30, 16-24

Clinical Simulation in Nursing

www.elsevier.com/locate/ecsn

Featured Article

Interprofessional Simulation—Based Advanced Cardiac Life Support Training: Video-Based Observational Study

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KEYWORDS
simulations;
interprofession;
team performance;
video;
nursing education

Abstract

Background: Interprofessional simulation—based advanced cardiac life support (IPS-ACLS) training provides opportunities for nursing and medical students to enhance their performance in clinical situations.

Method: A video observational quantitative design was used using the Clinical Teamwork Scale and Communication and Team Skills Assessment in the center for health care simulation of one Baccalaureate University.

Results: A total of 80 teams participated in the study. The total scores of the Clinical Teamwork Scale and Communication and Team Skills Assessment were improved substantially after the IPS-ACLS ($p < .001$).

Conclusions: Our result suggested that the IPS-ACLS could enhance team performance ($d = 2.1$). Thus, it helps undergraduate students prepare thoroughly for collaborative real-world practice.

Cite this article:
Lau, Y., Chee, D. G. H., Ab Hamid, Z. B., Leong, B. S.-H., & Lau, S. T. (2019, May). Interprofessional simulation—based advanced cardiac life support training: video-based observational study. *Clinical Simulation in Nursing, 30*(C), 16-24. https://doi.org/10.1016/j.ecns.2019.03.001.

Cardiac arrest is a leading cause of death, and advance cardiac life support (ACLS) training is a solution for critical situations (Soar et al., 2015; Webster et al., 2018). ACLS is a technically challenging procedure used for the urgent

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https://doi.org/10.1016/j.ecns.2019.03.001

treatment of life-threatening cardiac events; this procedure requires extensive multidisciplinary coordination to be initiated rapidly and effectively (Brewster et al., 2017). The importance of interprofessional simulation−based training is increasingly being recognized to enhance clinical performance and reduce the incidence of medical negligence (Amatullah, 2018). Simulation allows students to function as professionals with credentials and focuses on prioritization, teamwork, and effective communication (Watts et al., 2014). Resuscitation skill training in undergraduate curricula largely occurs in uniprofessional education (O'Connor, 2018), whereas interprofessional education (IPE) offers an alternative way to improve resuscitation training collaboratively (Webster et al., 2018). IPE should begin in undergraduate programs because this approach benefits undergraduate students by enhancing their clinical preparedness (Webster et al., 2018), satisfaction, confidence, and role understanding (Brewster et al., 2017).

Key Points

- Simulation allowed the students to function as credentialed professionals and focused on prioritization, teamwork, and effective communication.
- The interprofessional simulation−based advanced cardiac life support training is designed to improve the students' preparedness to respond to an emergency requiring resuscitation.
- Interprofessional simulation−based training effectively improves team performance among nursing and medical students.

Given that a team of nursing and medical staff continually manages most resuscitation events, the quality of teamwork has been suggested to play a role in patient outcome (Brewster et al., 2017; Gilfoyle et al., 2017). The Institute of Medicine identified interprofessional teamwork as a core competency for all health care providers (Institute of Medicine, 2011). Teamwork is a dynamic process that includes behaviors, cognitions, and attitudes, which render interdependent performance possible (Gittell, Beswick, Goldmann, & Wallack, 2015). The benefits of good teamwork in health care have been linked to improvement in patient outcome and health care efficiency (Sacks et al., 2015). Nursing and medical students should be prepared to collaborate with each other in the workplace to deliver high-quality health care in a collaborative team atmosphere (Wang & Petrini, 2018; World Health Organization, 2010).

Background

Considering that interprofessional simulation−based training may positively influence patient safety and quality of care (Amatullah, 2018), our research team has initiated interprofessional simulation−based ACLS (IPS-ACLS) training for nursing and medical students since 2016. The IPS-ACLS was designed to allow nursing and medical students to interact with one another in preregistration education through different simulation scenarios in a team approach. The purpose of training was to prepare nursing and medical students to further readily enter the clinical setting armed with collaborative skills in clinical emergencies. Simulation offers interactive clinical learning to (a) assess critical patient physiologic parameters through observation and communication, (b) plan appropriate management according to different simulation scenarios, (c) intervene to stabilize the situation, and (d) evaluate the condition of patient (Moore & MacArthur, 2018). Our team used interprofessional simulation as a strategy to introduce team-based concepts in a controlled environment.

The pedagogical blueprint of IPS-ACLS training is based on the integrated concepts of the Interprofessional Education for Collaborative Patient-centered Practice (IECPCP) framework (D'Amour & Oandasan, 2005), social cognitive theory (SCT) (Bandura, 1977), and TeamSTEPPS teamwork model (Salas, Sims, & Burke, 2005). The IECPCP (D'Amour & Oandasan, 2005) attempted to bridge educational and professional systems through collaborative learning experience. Meanwhile, the SCT (Bandura, 1977) suggested learning through observation, perceptions, and experience. The TeamSTEPPS model proposed four core teamwork skills for improving team performance including leadership, situation monitoring, mutual support, and communication (Gittell et al., 2015; Salas et al., 2005). These three concepts helped design different pedagogical components, including active learning, problem-based learning, reflection, and role modeling, for the training.

The program lasted for two days, and its outline is presented in Table 1. In this training, fourth-year nursing students and fifth-year medical students were invited, given their probably high readiness in working together for a joint learning experience (Furseth, Taylor, & Kim, 2016). The training was expected to be instrumental in preparing nursing and medical students for emergencies in real-world practice. Each training session involved three senior consultants and 12 certified ACLS instructors from the emergency department, including advanced-practice nurses and physicians. All ACLS instructors had completed an ACLS instructors' course and simulation instructor training by center for health care simulation in the Baccalaureate University for equipping themselves to effectively instruct nursing and medical students in the IPS-ACLS training.

Identical training sessions were conducted four times annually, and each training session consisted of 92 to 113 fourth-year nursing students and fifth-year medical students. The mode of teaching and learning included six large groups of interactive lectures and nine small groups of simulation sessions. Lecturers introduced new knowledge based on ACLS algorithms involving entire students in a lecture theatre. A large group lecture produced a sense of

Table 1 Outline of 2-Day Interprofessional Simulation—Based Advanced Cardiac Life Support Training Program

Description of 2-day IPS-ACLS Training		
Intended learning objectives	Interactive lecture: To introduce new knowledge according to ACLS algorithms Simulation session: To allow nursing and medical students to apply the knowledge and skills using different scenarios	
Participants	A total of 445 fifth-year medical students and fourth-year nursing students in four identical interprofessional advanced cardiac life support program	
Providers	Three senior consultants and 12 certified ACLS trainers from the emergency department	
Class size in interactive lecture	92-113 fifth-year medical students and fourth-year nursing students	
Team size in each skill station	5-7 members per team including 3-4 fifth-year medical students and 2-3 fourth-year nursing students	
Time	Day 1	Day 2
0800-0900	Interactive lecture: Introduction and ACLS Guidelines	Interactive lecture: Basic ECG and acute myocardial infarction
0900-1000	Interactive lecture: CPR, Defibrillation, Airway, Ventilation	Interactive lecture: Special considerations in resuscitation
1000-1100	Prebriefing: Preparatory instruction Simulation station: High-quality CPR	Simulation station: Universal algorithm 1
1100-1200	Simulation station: Defibrillation	Simulation station: Universal algorithm 2
1200-1300	Simulation station: Ventilation and Airway	Simulation station: Universal algorithm 3
1300-1400	Lunch	
1400-1500	Interactive lecture: Wide and narrow complex tachycardia and bradycardias	Interactive lecture: ROSC/Postarrest bundle, hypotension, shock and APO and drugs
1500-1600	Simulation station: Cardioversion	Simulation assessment: Universal algorithm
1600-1700	Simulation station: Pacing	Debriefing (after each simulation scenario): Feedback and reflection

Note. ACLS = advanced cardiac life support; APO = acute pulmonary oedema; CPR = cardiopulmonary resuscitation; ECG = electrocardiogram; ROSC = return of spontaneous circulation; IPS-ACLS = interprofessional simulation—based advanced cardiac life support.

community and a shared communal understanding among nursing and medical students (French & Kennedy, 2017). Prebriefing was conducted to provide preparatory instructions before the simulation. Simulation sessions involved the use of a high-fidelity simulation manikin in a team approach. Simulation sessions allowed five to seven nursing and medical students to apply their knowledge and skills under different scenarios in a simulation laboratory. The simulation scenarios were developed by three senior consultants from the emergency department and groups of certified ACLS instructors according to the ACLS guidelines (Ching et al., 2017).

The simulation experience comprised nine different simulation scenarios and each group needed to finish nine stations in two days. Twelve simulation laboratories were operated simultaneously using identical simulation scenario. Each certified instructor was a facilitator at each skill station, and each team circulated around the nine skill stations. The students were guided through interteam communications and task delegation to deliver timely, rapid, and coordinated resuscitation. Each student alternately played the role of leader and teammate in each scenario. The level of scenario difficulty was gradually increased from first simulation scenario to final simulation scenario that planned to match the complexity of real resuscitation and students' level of expertise (Amatullah, 2018). When students demonstrated concept mastery, the facilitator increased the scenario difficulty level, ensuring that students were optimally challenged to enhance attentiveness and metacognitive growth (Watts et al., 2014). Simulation session intended to help students prioritize patient care and communicate effectively with teammates (Amatullah, 2018; Cheng et al., 2015). Each simulation scenario ran 30 to 40 minutes and followed by 10 to 20 minutes for a debriefing.

Debriefing session aimed toward promoting reflective thinking, self-regulation, and self-direction to apply forethought and intentionality to optimize performance (Levett-Jones & Lapkin, 2014; Sawyer, Eppich, Brett-Fleegler, Grant, & Cheng, 2016). Debriefing after each simulation scenario allowed the timely integration of teaching and focus on student-centered concerns, interests, and the needed areas of improvement (Decker et al., 2013). Each ACLS instructor provided open communication and self-analysis, and reflection (Decker et al., 2013; Sawyer et al., 2016). Debriefing strategies including creation of safe environment, immediately after simulation, asking open-end questions, reflective discussion, and provision of constructive feedback were used (Levett-Jones & Lapkin, 2014; Sawyer et al., 2016).

Although evidence on the development and delivery of interprofessional simulation–based training is increasing, video-based observational study for interprofessional resuscitation training is limited. The use of videos allowed the objective assessment of nonverbal behavior and provided rich data about the complex nature of human interaction (Asan & Montague, 2014). Whether or not positive effects resulted from the IPS-ACLS training among the undergraduate nursing and medical students is unknown. This study aimed to evaluate the team performance of the fourth-year nursing and fifth-year medical students after IPS-ACLS training. The results of this study can guide the ongoing pedagogical restructuring of the IPS-ACLS training program among undergraduate students.

Methods

Design

A video observational study was used for team performance assessment through simulated resuscitation scenarios. Visual data may constitute a valid methodological approach in the collection, analysis, and reporting of the study (Smith, Mountain, & Hawkins, 2016). The clinical session of this study was conducted in a simulation laboratory in the center for health care simulation of one Baccalaureate University. Each simulation laboratory has a video-recording system, and each simulation scenario is routinely recorded as part of teaching practice. Three team members of this study as raters reviewed the performance of 80 teams independently before and after the IPS-ACLS training in accordance with behavioral markers of team performance observation tools. The first simulation scenario in day one was used as the "pre" team performance, whereas the final simulation scenario in day two was used as the "post" team performance. When inconsistencies exist among the three raters, the videos were reviewed for verification. The raters solved the discrepancies by reaching a consensus through discussion.

Sample Size

A sample size of 80 teams was calculated to achieve a power of 80% and a level of significance of 5% (two sides) (Dhand & Khatkar, 2014) by using the expected mean of the paired differences of team performance scores (0.16) between pairs under the assumption of the standard deviation of paired differences (0.50) from a previous similar study (Gilfoyle et al., 2017) with an expected effect size of 0.5. An improvement of the mean score from 0.56 to 0.72 (Dhand & Khatkar, 2014) was deemed clinically meaningful by the investigators. All eligible students were recruited on a voluntary basis. Each student completed the demographic characteristics, including gender, age, and discipline, before participation in this study. Two team performance observation tools were used to validate the visual data.

Clinical Teamwork Scale

The Clinical Teamwork Scale (CTS) was used to assess team effectiveness and communication skills (Guise et al., 2008). The CTS consists of 15 items with a score from 0 (unacceptable) to 10 (prefect) for 14 items to assess five teamwork domains, such as communication, situational awareness, decision-making, role responsibility, and patient friendliness (Guise et al., 2008). One item is about the presence of target fixation using dichotomous response (yes or no) (Guise et al., 2008). If team members demonstrate tunnel vision to prevent progress in the management of a scenario, target fixation exists (Guise et al., 2008). The items of the CTS reflect the nontechnical skill domains necessary in a clinical situation. A systematic review ranked this scale as the most reliable tool for assessing teamwork (Miller, Crandall, Washington III, and McLaughlin, 2012) that was well-supported with satisfactory inter-rater reliability (Onwochei, Halpern, & Balki, 2017). The coefficient alpha of the CTS was 0.961 to 0.97 in this study, thereby indicating excellent tau-equivalent reliability (Cronbach, 1951).

Communication and Teamwork Skills Assessment

The Communication and Teamwork Skills Assessment (CATS) scale was used to evaluate teamwork and communication (Frankel, Gardner, Maynard, & Kelly, 2007). The CATS scale consists of 21 items and includes the categories of coordination of care, situational awareness, cooperation, and communication for 18 different behaviors rated as 0 (expected but not observed), 0.5 (observed inadequate), and 1 (observed adequate) (Frankel et al., 2007). Raters score the behavior on the basis of the definition in the glossary. Scoring is based on the total number of observations and the quality of the observed performance. Scores are then added together to determine the weighted total. The quality score of the behavior indicates the weighted total divided by the total number of marks expressed in a hundred-point scale. The CATS has three additional behaviors in the categories of coordination, cooperation, and communication that are rated if a crisis situation arises (Frankel et al., 2007). The internal consistency of the CATS scale was 0.830 to 0.848 in this study and indicates satisfactory reliability (Cronbach, 1951).

Data Collection

Our target population in the data collection period from January 5, 2017 to August 29, 2018 was composed of nursing and medical students registered in the IPS-ACLS. Three trained video raters participated in this study. All raters for the CTS and CATS were trained and calibrated through a one-day in-person training session by principal investigator involving an interactive review, scoring, and discussion of several different videos demonstrating poor, good, and excellent team performance. All scenarios in each simulation laboratory were recorded using a video-recording system. One research team member, who was not involved in the video review, selected scenario videos before and after the IPS-ACLS training, uploaded the videos in random order, and named the videos in a blinded fashion. Hence, all raters were blinded to the order of the video. To eliminate the bias, we rearranged the sequence of the videos from the consecutive order. Three independent raters viewed the scenario videos for 80 teams, each for about 15 minutes to 20 minutes, and completed the CTS and CATS scales.

Data Analysis

Data analysis was conducted using the IBM SPSS Statistics 25.0 (IBM Corporation, Armonk, NY, USA). Descriptive statistics were applied to the demographic characteristics. Mean and standard deviation were used for normally distributed CTS and CATS scales scores, whereas median and interquartile range were used for non-normally distributed scores. Gwet's Agreement Coefficient (AC) were calculated to examine the inter-rater agreement among the three independent raters (Gwet, 2014). The Gwet's AC statistic can adjust the overall probability based on the chance that raters may agree on a rating (Wongpakaran, Wongpakaran, & Gwet, 2013). The values of Gwet's AC were as follows: <0.2 = poor, 0.21 to 0.40 = fair, 0.41 to 0.60 = moderate, 0.61 to 0.80 = good, and 0.81 to 1 = very good (Gwet, 2014). Reliability tests for the CTS and CATS were carried out to test their internal consistency; the Cronbach's alpha coefficient ≥ 0.70 was considered satisfactory (Cronbach, 1951). The total and subscale scores of the CTS and CATS were determined for normality by using the values of skewness and kurtosis (± 2) (George, 2011), the Kolmogorov-Smirnov test ($p > .05$) (Ghasemi & Zahediasl, 2012), and Shapiro-Wilk test ($p > .05$) (Shapiro & Wilk, 1965). Paired *t*-tests was used for normally distributed data, whereas the Wilcoxon signed-rank test was adopted for the data that were not normally distributed to compare the total and subscale of CTS and CATS scores between before and after the IPS-ACLS. Differences at $p < .05$ were considered statistically significant. In addition, we calculated the pretest/posttest differences in the various scores in terms of standard deviation united (effect size estimates, ES) using the following formula: ([post-pretest]/pretest standard deviation). The ES is a useful indicator of the clinical results that can be operationally defined as d (0.01) = very small, d (0.2) = small, d (0.5) = medium, d (0.8) = large, d (1.2) = very large, and d (2.0) = huge (Sawilowsky, 2009).

Ethical Considerations

Ethical approval was obtained from the University Institutional Review Board (IRB no.: B-16-197). All students were verbally assured that participation in the study would not affect their learning and grades in any modules. Written and informed consent was obtained after a full explanation of the study. A list of the participants' names and their corresponding assigned anonymous code numbers were stored separately from the actual data.

Results

A total of 80 teams participated in the study involving medical and nursing students. The age ranged from 21 years to 25 years. The males were 35%, whereas the females 65%, of the total population. Each team consisted of two to three nursing students and three to four medical students. We calculated Cohen's kappa coefficient to assess the interrater reliability among three independent raters. The value of Gwet's AC between raters 1, 2, and three was 0.76, thereby indicating a good agreement among the three raters (Gwet, 2014). Table 2 summarizes the values of skewness (-3.06 to 3.30) and kurtosis (-0.73 to 12.49), the Kolmogorov-Smirnov test ($p < .05$) and Shapiro-Wilk test ($p < .05$) for the total and subscales of the CTS and CATS scores. Given that most CTS and CATS scores (Table 2) were not normally distributed (George, 2011; Ghasemi & Zahediasl, 2012; Shapiro & Wilk, 1965), the Wilcoxon signed-rank test was used to compare the scores before and after the IPS-ACLS.

Table 3 shows the changes in prescores and postscores for the subscales and total CTS and CATS. The Wilcoxon signed-rank test results showed a significant difference: the median (Interquartile range) pretest and post-test scores for the overall score of CTS were 41.0 (35.00-48.00) and 65.5 (55.25-73.75), respectively ($p < .001$). The effect size was 1.8, thereby showing that the IPS-ACLS had a large effect in improving team performance. All subscales of CTS were enhanced significantly ($p < .01$) after the IPS-ACLS included overall teamwork, communication, situation awareness, decision-making, role responsibility, and patient friendliness. Similarly, the Wilcoxon signed-rank test revealed post-test improvement in the overall scores for the CATS 1.5 (1.50-2.50) to 2.5 (1.50-4.38). The result showed that the IPS-ACLS is important, as indicated by the medium to large effect size of 0.5. Most CATS subscales, such as situational awareness, cooperation, communication, and crisis situation, were improved significantly after IPS-ACLS training. Notably, the score reduction of coordination was insignificant ($p = .366$).

Discussion

In this observational study, video recordings were used to assess the team performance before and after participation in the IPS-ACLS. The IPS-ACLS provided practical learning (Reime et al., 2017) and collaborative learning

Table 2 Skewness and Kurtosis of the Clinical Teamwork Scale and Communication and Teamwork Skills Assessment Total and Subscale Scores

	Before IPS-ACLS						After IPS-ACLS					
IPS-ACLS	Skewness	Kurtosis	KS	*p*	SW	*p*	Skewness	Kurtosis	KS	*p*	SW	*p*
Clinical teamwork Scale												
Total score	1.17	1.72	0.14	<.001	0.91	<.001	−0.09	−0.73	0.07	.20	0.97	.086
Subscale score												
Overall teamwork	0.84	0.83	0.26	<.001	0.83	<.001	0.13	−0.68	0.23	<.001	0.88	<.001
Communication	1.25	4.00	0.17	<.001	0.91	<.001	−0.17	−0.54	0.14	.001	0.97	.052
Situational awareness	0.58	0.28	0.13	.002	0.96	.007	−0.08	−0.47	0.14	.001	0.96	.013
Decision-making	1.03	1.11	0.27	<.001	0.85	<.001	−0.07	−0.88	0.22	<.001	0.89	<.001
Role responsibility	1.00	0.91	0.21	<.001	0.89	<.001	−0.20	−0.56	0.21	<.001	0.92	<.001
Patient friendly	−3.06	9.47	0.52	<.001	0.37	<.001	0.00	0.00	—	—	—	—
Communication and teamwork skills assessment												
Total score	3.23	12.49	0.27	<.001	0.61	<.001	1.28	1.41	0.17	<.001	0.87	<.001
Subscale score												
Coordination	3.70	13.79	0.53	<.001	0.32	<.001	3.29	9.04	0.54	<.001	0.29	<.001
Situational awareness	1.98	3.32	0.47	<.001	0.57	<.001	1.59	0.94	0.44	<.001	0.58	<.001
Cooperation	2.92	12.24	0.31	<.001	0.64	<.001	0.61	0.24	0.23	<.001	0.92	<.001
Communication	1.95	6.00	0.34	<.001	0.73	<.001	0.97	0.71	0.31	<.001	0.85	<.001
Crisis situation	2.02	4.72	0.36	<.001	0.67	<.001	1.44	1.87	0.28	<.001	0.76	<.001
Overall score (%)	3.30	12.49	0.27	<.001	0.61	<.001	1.28	1.41	0.17	<.001	0.87	<.001

Note. IPS-ACLS = interprofessional simulation—based advanced cardiac life support; KS = Kolmogorov-Smirnov test; SW = Shapiro-Wilk Test.

(D'Amour & Oandasan, 2005) opportunities related to real clinical scenarios that supported the strategy of learning by doing to gain the competencies to work collaboratively with medical students. The IPS-ACLS promotes experiential learning in a simulated environment to support the students' learning of clinical skills (Cheng et al., 2015; Doody & Condon, 2013). Our observational data yielded the objective results by three independent raters, and inter-rater reliability was acceptable in this study. By objectively assessing the team performance, we found that scores of CTS and CATS were improved significantly after the IPS-ACLS trainings. The results are consistent with those obtained in a previous study (Gilfoyle et al., 2017). In our study, all fourth-year nursing and fifth-year medical students were recruited from same cohort and they were educated at the same period of time. Hence, they had similar previous IPE experience and similar clinical exposure during clinical practicum. Senior nursing (fourth-year) and medical (fifth year) students are more ready for the IPS-ACLS training than students of other levels because the former have a better understanding of their own professional identities and the roles and responsibilities of other professionals (Feltham, Foster, Davidson, & Ralph, 2016; Furseth et al., 2016). These senior students can mutually respect and trust each other's contributions (Kumar et al., 2017) and have equitable opportunities for input into decision-making and communication to provide quality outcomes (World Health Organization, 2010). There may be a bidirectional socialization process that occurs during continuous interaction of different simulation scenarios according to the IECPCP framework (D'Amour & Oandasan, 2005). Given that the IPS-ACLS training provided opportunities to have collaborative practice (D'Amour & Oandasan, 2005), team performance skills of nursing and medical students could be enhanced at the end of the training. This finding may be linked to the enhancement of the self-efficacy among nursing and medical students' belief in their ability, as indicated by SCT (Bandura, 1977). Such enhancement is in turn linked to improved team performance (Jansen, Scherer, & Schroeders, 2015).

In another possibility, undergraduate students may have a shared mental model of the required goals or the best approach to the task at hand (Newell & Bain, 2018). Based on the TeamSTEPPS framework (Gittell et al., 2015; Salas et al., 2005), a shared mental model helped each group to develop team knowledge and skills and nursing and medical students had the capacity to develop common understandings of team environment to provide mutual support and efficient communication. Consequently, team performance skills of groups were improved through this training. Given the interdependent nature of the tasks, teammates combine their own inputs and efforts with those of their teammates to accomplish shared goals (Gittell et al., 2015; Watts et al., 2014). Team members are more likely to adhere to resuscitation guidelines (Gilfoyle et al., 2017). The simulation experience helps students develop team-based competencies that may improve their recognition and response to critical events (Kumar et al., 2017). Their situation awareness may improve, resources may

Table 3 Comparisons of Team Performance Scores Before and After Interprofessional Simulation—Based Advanced Cardiac Life Support Training Among 80 Teams

IPS-ACLS	Before IPS-ACLS Median (Interquartile Range)	After IPS-ACLS Median (Interquartile Range)	*p*-value	*d*
Clinical Teamwork Scale				
Total score	41.0 (35.00-48.00)	65.5 (55.25-73.75)	<.001*,***	1.8
Subscale score				
Overall teamwork	3.0 (3.00-3.00)	4.0 (4.00-5.00)	<.001*,***	2.0
Communication	11.0 (9.0-13.0)	18.5 (15.00-21.00)	<.001*,***	1.9
Situational awareness	12.5 (10.0-14.0)	16.0 (15.00-18.00)	<.001*,***	1.5
Decision-making	4.0 (4.00-6.00)	8.0 (6.00-10.00)	<.001*,***	1.8
Role responsibility	8.0 (6.00-9.00)	14.0 (12.00-15.00)	<.001*,***	1.6
Patient friendly	4.0 (4.00-4.00)	4.0 (4.00-4.00)	.004*,**	0.5
Communication and Teamwork Skills Assessment				
Total score	1.5 (1.50-2.50)	2.5 (1.50-4.38)	<.001*,**	0.5
Subscale score				
Coordination	0.0 (0.00-0.00)	0.0 (0.00-0.00)	.366*	0.1
Situational awareness	25.0 (25.00-25.00)	25.0 (25.00-50.00)	.001*,**	0.3
Cooperation	8.3 (8.33-16.67)	16.7 (16.67-25.00)	<.001*,*	0.6
Communication	8.3 (2.08-8.33)	8.3 (8.33-16.67)	.001*,**	0.4
Crisis situation	0.0 (00.00-16.67)	8.33 (0.00-33.33)	<.001*,***	0.3
Overall score (%)	7.1 (7.14-11.90)	11.9 (7.14-20.83)	<.001*,***	0.5

**$p < .01$.
***$p < .001$.
Note. IPS-ACLS = interprofessional simulation—based advanced cardiac life support program; *d* = effect size estimation.
* Wilcoxon signed-rank test.

arrive in a timely fashion, all may share information, and teammates may feel comfortable communicating and collaborating within a team (Krueger, Ernstmeyer, & Kirking, 2017). Consequently, students function effectively as members of a multidisciplinary health care team (Furseth et al., 2016).

Our results highlight that the IPS-ACLS may be insufficient to improve coordination. Resuscitation requires a coordinated interprofessional team (Gilfoyle et al., 2017). Thus, the coordination ability among medical and nursing students must be improved. The coordination inherent in teamwork enables team members to manage complexity and adapt to changing circumstances. Multiple levels of teamwork exist, and the coordination can be learnt from teamwork intervention based on TeamSTEPPS principles (Gittell et al., 2015). Coordination requires some shared accountability between team members and clarity of their goals, roles, and tasks (Hustoft, Biringer, Gjesdal, Aβmus, & Hetlevik, 2018). Hence, a contingency approach is needed when we design interprofessional training in the future and includes shared team identity and responsibility; clear team goal, role, and task; integration; and interdependence (Reeves, Xyrichis, & Zwarenstein, 2018).

Implication

Our findings suggest that the IPS-ACLS can be used with preregistered students to improve team performance. Simulation provides a safe learning environment to learn prioritization and interteam communication (Amatullah, 2018; Watts et al., 2014), and interprofessional approach overcomes the silo effect and develops an enhanced understanding of the roles of each team member (O'Connor, 2018). A planned debriefing session is considered to be a standard of best practice to ensure the best possible learning and promote reflective thinking in simulation-based training (Decker et al., 2013). The IPS-ACLS can cultivate unprejudiced impressions of interprofessional concepts among undergraduate students (Kumar et al., 2017). However, repetitive experiences in interprofessional simulation—based training are needed to produce steady changes in behavior and attitude (Garbee et al., 2013), which can promote transformational change in hospital safety culture (Escher et al., 2017). Although the resources are limited and scheduling conflicts are present in the IPE program, the training should be introduced early for collaborative practice familiarization to develop interprofessional competencies before the students are licensed in their respective professions. Interprofessional simulation—based training has been proposed as a strategy to improve team performance among nursing and medical students. Furthermore, the IPS-ACLS training can introduce for practicing health care providers in various acute care settings, who are working in interprofessional teams, to improve resuscitation skills and team performance.

Strengths and Limitations

The strength of the present study is the objective assessment of nursing and medical students' performances in a simulation laboratory through video-recording. Video-recording accurately records simulation scenarios, allow raters to verify their observations, and allow for the collection of systematic feedback by means of strategic review (Asan & Montague, 2014; Seagull & Guerlain, 2003). The opportunity to analyze the videos allowed the evaluation of the complex interaction that can provide useful and valid data (Asan & Montague, 2014). Video data can capture all interactions in detail such as body language and gazing direction that provide a consistent way to assess observable behavior according to behavioral markers of team performance observation tools (Kumarapeli & de Lusignan, 2012). As observed in previous studies (Smith et al., 2016; Trevisanuto et al., 2015), video-recording is useful for the objective assessment of team performance during resuscitation training that can be used as an educational tool. The sample was derived from one Baccalaureate University in Singapore, and student participation was based on a convenience sample that limited the transferability of the findings. Given that all eligible students were recruited on a voluntary basis and therefore prone to the effects of selection bias. All participants might have different confidence and competence in the skill sets that could impact the results. Our study used the first and final simulation scenario as the ''pre'' and ''post'' team performance markers and each group facilitated by the different certified ACLS instructor that may affect the comparison and standardization. A disproportionate number of nursing and medical students in scenario-based training may not exactly reflect an actual resuscitation team in real-life situations.

Conclusions

Simulation offers effective and interactive clinical learning opportunities. Our findings suggested that the IPS-ACLS training could augment teamwork performance among nursing and medical students. Interprofessional coordination needs to be strengthened for the pedagogical restructuring of the IPS-ACLS training. Considering the increasing complexity of the contemporary clinical situation, effective teamwork in multidisciplinary practice is critical to patient safety and quality of care. Interprofessional simulation—based approach is an effective strategy to prepare students to further readily respond to a real-world emergency requiring resuscitation.

Acknowledgment

The authors express gratitude to all participants, lecturers, trainers, and laboratory technicians in the simulation centre for their valuable times and support.

This work was supported by Teaching Enhancement Grant, National University of Singapore, Singapore [Grant numbers: TEG AY2016/2017].

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