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Featured Article

How Does Simulation Impact Building Competency and Confidence in Recognition and Response to the Adult and Paediatric Deteriorating Patient Among Undergraduate Nursing Students?

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Abstract

Background: The ability to recognize and respond to a deteriorating adult or paediatric patient is critical to prevention of poor patient outcomes. Simulation is one teaching/learning strategy that can prepare nursing students as they plan to transition to practice. Recognition and response to haemodynamic instability, respiratory distress, cardiac arrest, a massive haemorrhage, or a paediatric seizure has the potential to save patient lives.

Method: In this quasi-experimental pre/post study, participants were randomly assigned to a treatment or a control group (N = 59). The treatment group received a 16-hour simulation intervention held over two days that were two weeks apart. In addition, the treatment group completed two virtual simulations (one adult and one paediatric case).

Results: A new measure, Clinical Self-efficacy, was piloted in this study and showed a high internal consistency (0.91). Significant improvement in all items on the Clinical Self-efficacy tool was seen in the treatment group after the intervention. On the contrary, there was no significant improvement in any of the Clinical Self-efficacy items in the control group.

Conclusion(s): The hybrid simulation intervention proved effective in improving confidence and competence in the recognition and response to deteriorating patients. Further multisite research is needed to further explore the significance of the simulation intervention.

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As simulation continues to gain traction in the preparation of undergraduate nursing students, specific strategies are being developed to enhance performance in the practice area. One such strategy includes a comprehensive high-

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fidelity simulation intervention that was aimed at improving recognition and response to the rapidly deteriorating patient. The intervention includes paediatric and adult-based acute care scenarios. Students are exposed to a hybrid approach to simulation with opportunities to complete both high-fidelity and virtual simulation cases. The simulation cases were developed and tested using best practices in simulation which included the following: The International Nursing Association for Clinical Simulation and Learning simulation standard IX: simulation design (Lioce et al., 2015), content expert panels, the utilization of peer-reviewed simulation case templates (Goldsworthy & Graham, 2013), and a "dry run" with subsequent refinement of all cases. Prebriefing of students was completed through required pre-readings, an overview of the learning objectives, and an orientation to the simulation learning space. In addition to the preparation of the students, the instructor team was prebriefed by reviewing and running all the cases and the evaluation tools and participating in a dry run and setup of the learning stations.

Key Points

- A new Clinical Self-efficacy measure was developed and tested in this study and showed high internal consistency (0.91).
- The treatment group showed significant increase in competence in all areas after intervention.

Literature Review

Newly graduated nurses face significant challenges when exposed to the real-life clinical situation of a rapidly deteriorating patient. The graduate nurses' challenges may be associated with limited exposure to clinical situations requiring the students to identify and manage the deteriorating patient (Bogossian et al., 2014). Limited assessment skills acquired during training decreases students' ability to recognize the key signs of acute illness and deterioration. To optimize students' skills for assessing and managing acutely ill and deteriorating patients, the National Institute for Health and Care Excellence (2007) and the UK Resuscitation Council (2010) recommend the teaching of critical assessment skills in undergraduate nursing programs. Some authors argue that didactic methods of teaching and assessing critical assessment skills do not adequately prepare students for clinical practice (Buykx et al., 2011). The authors believe that simulation represents the ideal strategy for nursing students to develop, refine, and rehearse clinical skills in recognizing and responding to patient deterioration in a safe environment. In the following section, knowledge and skills performance, self-efficacy, self-confidence, and situation awareness are explored.

Knowledge and Skills Performance

Simulation provides an opportunity for students to connect theory to practice. Competency checklists allow assessment of nursing student performance in the simulation laboratory by totalling the number of correct actions taken (Cooper et al., 2010). Skills performance can be measured using an objective structured clinical examination (Merriman, Stayt, & Ricketts, 2014) instrument, and knowledge can be assessed with the use of knowledge questionnaire (Cooper, Bogossian, Porter& Cant 2014; Cooper et al., 2010, 2016). Objective structured clinical examinations are typically assessing singular skills (i.e., medication administration) contrasted with simulation cases that provide a comprehensive opportunity to care for a "patient" in the simulation laboratory and involve multiple skills, prioritization, and communication behaviours.

In multiple studies, investigators examined, in simulated environments, the ability of undergraduate nursing students to assess, identify, and respond to patients deteriorating or at risk of deterioration (Buckley & Gordon, 2011; Kelly, Forber, Conlon, Roche, & Stasa, 2014). The investigators found significant increases in student nurses' knowledge, skills performance, confidence, and perception of team work following simulation experiences (Buckley & Gordon, 2011; Cooper et al., 2015a, b; Davies, Nathan, & Clarke, 2012; Kelly et al., 2014; Liaw, Zhou, Lau, Siau, & Chan, 2014).

In an exploratory study of theoretical and applied learning in response to a virtual simulation program, FIRST2ACT WEB™, investigators found enhanced knowledge and skills, improved virtual clinical performance, and increased confidence and competence in final year nursing students (Bogossian et al., 2015; Cant, Young, Cooper, & Porter, 2015; Cooper et al., 2015a, b). The benefits of face-to-face approach during these simulation events were the ability to work as a team, receive face-to-face briefings, and offer in-depth feedback (Cooper et al., 2015a, b, 2016). Combining structured education curriculum with simulation training also improves nursing students' performance in recognizing and responding to clinical deterioration (Hart, et al., 2014a, b).

Theoretical Framework

This study was underpinned by Bandura's (1986) social cognitive theory, in which an individual's reactions and actions are based on what the individual has observed in others. The concept of self-efficacy arises from social cognitive theory and is broadly defined as: "… people's judgements about their capabilities to organize and execute courses of action required to attain designated types of performance; it is concerned not with the skills one has but

with judgements of what one can do with whatever skills one possesses'' (Bandura, 1986, p. 391).

An individual's self-efficacy can influence how they approach tasks and new challenges, such as learning situations such as a competency development in recognizing a patient that is deteriorating. Self-efficacy is conceptualized as being general or domain specific. General self-efficacy is a trait-like generality dimension defined as: ''… an individual's perception of their ability to perform across a variety of situations'' (Judge, Erez, & Bono, 1998, p. 170). Domain-specific self-efficacy refers to how an individual feels capable of approaching and performing specific tasks, such as competencies in approaching and caring for a deteriorating patient (Bandura, 1986). Domain-specific self-efficacy is typically developed through mastery experiences and through vicarious learning and modelling by observing others perform the task (Bandura, 1986). Mastery experiences are largely gained through hands-on experience, as through practice in the clinical setting with patients or through practice in the simulation laboratory with simulated patients. Bandura (1986) also argued that self-efficacy develops with opportunity to repeat tasks. Individuals that have increased levels of self-efficacy feel they can have an impact on their environment, whereas individuals with low levels of self-efficacy view problems as unmanageable and insurmountable. Individuals with low self-efficacy may avoid a situation, instead of facing a task, if they may not be able to do it. Research on self-efficacy in relation to training interventions is important in the understanding of effective training. An individual with higher self-efficacy is more likely to make an effort and persist longer at a task, compared to those with lower self-efficacy.

Studies in the nursing population have explored the influence of self-efficacy and performance for specific tasks. In one study exploring self-efficacy in the nursing population, a simulation intervention was delivered to 112 undergraduate nursing students (Bambini, Washburn, & Perkins, 2009). In the intervention, the training included maternal/child scenarios that mimicked the real practice settings, which were delivered via high-fidelity patient simulators. The results showed a significant increase in the levels of self-efficacy when pretests were compared to the posttest measures (Bambini et al., 2009).

Similar results were found in a US study (N = 49 registered nurses) where high-fidelity simulation training was conducted for preeclampsia and eclampsia management. Nurse levels of self-efficacy were significantly increased when the pretest and posttest were compared (Christian & Krumwiede, 2013). In addition, the levels of self-efficacy were found to be sustained over time when the posttests were readministered at eight weeks after intervention. In this single group design, the nurses also reported being highly satisfied with simulation as an effective teaching strategy.

Sample

After ethics approval was received from the university ethics board, nursing students in their third year were recruited through common classes into the study. The participants in this research included 63 undergraduate nursing students in their final year of their Bachelor of Nursing (BN) degree. The participants were randomly assigned to either the treatment group (n = 24) or the comparison group (n = 39).

Method

This study used a quasi-experimental design to test the effects of a 16-hour simulation intervention on third-year undergraduate nursing students' confidence and competence in the recognition and response to the rapidly deteriorating adult and paediatric patient. Students in the comparison group completed the baseline survey and a second survey aligned with the completion of the simulation intervention in the treatment group. Students in the treatment group completed pretests before each scenario and posttests at the completion of each scenario. Students in the treatment group attended two eight-hour simulation days in which they participated in a total of six scenarios on the first day and two weeks later attended a second 8-hour simulation day where all scenarios were repeated. In addition, students in the treatment group completed two virtual simulation case studies (adult cardiac arrest scenario and a paediatric asthma scenario - see Figure 1) in the time frame between the two high-fidelity case scenario days.

Deteriorating Patient: High-Fidelity Scenario Approach

Each high-fidelity scenario was run over one hour (Figure 2). The prebriefing period was 15 minutes in duration and included an orientation to the simulation space, simulator, role assignment, handover report, and pretest questions that were completed individually.

Each student was assigned a role and worked on the case in teams of four. Roles included primary nurse, secondary nurse, laboratory/diagnostics, and a pharmacology role. Students switched roles after each scenario to ensure they had participated in all roles. The intent was that the primary and secondary nurse completed the initial assessment at the head of the bed and the laboratory/diagnostics and pharmacology students worked at the foot of the bed reviewing laboratory and diagnostic results and doctor's orders and communicating this information to the students completing the assessments. Each case was repeated on the second day of the high-fidelity simulation to allow for increased mastery of the acute care medical surgical (adult and

Figure 1 Student paediatric simulation team.

paediatric) competencies. High-fidelity cases included the following: angina/cardiac arrest, COPD/respiratory failure, post-op haemorrhage, paediatric sepsis, paediatric asthma, neonatal seizures (Figures 1, 3).

All instructors were provided with a debriefing guide and debriefing questions. Because instructor experience varied in simulation debriefing and delivery of simulation, it was decided to use a plus/delta methodology for debriefing. Debriefing was completed directly at the bedside immediately after each simulation and was approximately 25 minutes in duration. In addition to debriefing, a posttest multiple choice/short answer quiz was delivered to assess knowledge after each simulation case.

Deteriorating Patient: Virtual Case Scenario Approach

In the virtual cases (VSim, Wolters Kluwer), students could repeat the cases as many times as they wanted to achieve mastery with the case. The virtual cases included an electronic preparation guide to orientate students to the program and technology before beginning the case. Each case also had suggested readings and pretest questions and answers to further prepare the student before entering each of the virtual cases. The virtual simulation program utilized allowed students to "drive" the scenario and end the scenario when they felt they had completed the needed assessments and interventions. At the conclusion of the case, the student was provided with a posttest, guided reflection questions and a debriefing log outlining how they performed in the case. The debriefing log also included comprehensive rationales for incorrect interventions and choices.

Figure 2 Timing of high-fidelity simulation delivery.

Measures

Two primary measures were used in this study. First, a new clinical self-efficacy measure (CSE) was developed to explore confidence in ten different areas related to recognizing and responding to the deteriorating patient. The CSE tool was developed through using Bandura's (2006) guide for developing domain-specific self-efficacy tools and demonstrated a high internal consistency of 0.91 in this study. The second measure was a multiple choice knowledge assessment related to each of the six deteriorating patient simulation cases in the intervention.

Data Analysis

Descriptive statistics provided a profile of the characteristics of the students in the treatment and comparison groups. We used paired and independent *t*-tests to determine whether there was a statistically significant mean improvement in the CSE after the intervention, within and between the treatment and comparison groups. Furthermore, within the treatment group, we tested for significant knowledge improvement at postintervention using Wilcoxon signed-rank test.

The assumptions of the paired and independent *t*-tests were tested. Normality was tested using Shapiro-Wilk test as the

Figure 3 High-fidelity simulation deteriorating patient scenario.

sample sizes were less than 50. Homogeneity of variances was tested using Levene's test. If the assumption of normality did not hold, we conducted a nonparametric test using Wilcoxon signed-rank test or Mann-Whitney test, as appropriate. A *p*-value of less than .05 indicated statistical significance throughout all inferential analyses. For multiple comparisons, *p*-values were adjusted using Holm-Bonferroni method. All analyses were conducted using IBM SPSS Statistics 24.

Results

Table 1 represents the baseline characteristics of students. About 62% of the students were initially assigned to the comparison group to allow for attrition. The average age of the students in the treatment and comparison group were similar being 26 years and 25 years, respectively. Other sociodemographic characteristics were also very comparable between these two groups including the majority of the students were female, speak English as their first language, and completed undergraduation as the highest level of education. After losing 20 students to follow-up, we ended up with nearly equal arms in the treatment and comparison groups by having 23 and 20 students, respectively.

Table 1 Baseline Characteristics of Students According to the Treatment Group

Variable	Treatment	Control
n (%)	24 (38.1)	39 (61.9)
Age, Mean (SD)	26.0 (6.9)	25.2 (6.0)
Gender, n (%)		
Female	19 (79.2)	37 (94.9)
Male	5 (20.8)	2 (5.1)
English as a First Language, n (%)		
No	8 (33.3)	4 (10.3)
Yes	16 (66.7)	35 (89.7)
Highest Level of Completed Education, n (%)		
Diploma	9 (37.5)	14 (36.8)
Undergraduate	14 (58.3)	19 (50.0)
Others	1 (4.2)	5 (13.2)

Note. N = sample size; SD = standard deviation.

Table 2 shows the within- and between-group pre-post intervention CSE improvement in the treatment and comparison groups. A preanalysis of principal component analysis showed that the largest eigenvalue of the sample data set is 7.98. Therefore, we were able to calculate the Cronbach's alpha for assessing the internal reliability of the CSE items with this sample size [1]. The Cronbach's coefficient alpha was 0.91, indicating strong internal consistency among the items.

After adjusting for multiplicity, we found significant CSE improvement in all items in the treatment group after the intervention. On the contrary, there was no significant improvement in any of the items in the comparison group. When conducting between-group comparisons, we observed the treatment group has significantly higher improvements in most of the CSE items than the comparison group.

Table 3 displays preintervention and postintervention knowledge comparison in the treatment group. From the *p*-values, we conclude that there has been a significant knowledge improvement in septic shock, myocardial infarction, and asthma after the intervention. Of note, paediatric asthma and myocardial infarction were the two

virtual simulations that the treatment group completed between the high-fidelity intervention days.

Implications

The results of this study have several implications for nurse educators. First, in this population, the hybrid simulation intervention that included a total of six high-fidelity simulation cases (three paediatric and three adult) and two virtual simulation cases (paediatric asthma and adult myocardial infarction) showed statistically significant increases in clinical self-efficacy among treatment participants in all domains. Furthermore, the treatment group in comparison with the comparison group showed significant increases in knowledge on three of the six domains (myocardial infarction, paediatric asthma, and septic shock). Of interest, two of the domains, paediatric asthma and myocardial infarction were the topics of the two virtual simulations. Significant findings in this area may be important in understanding the placement of virtual simulation in scaffolding learning and may also demonstrate the cumulative effect on learning in the simulation laboratory. For instance, are virtual simulations best placed in front of high-fidelity simulation experiences or in between simulation laboratory experiences? More exploration is needed to understand the placement of virtual experiences and how they might enhance learning.

Table 3 Pre—Post Intervention Knowledge Comparison in the Treatment Group

Knowledge Test	Preintervention	Postintervention	*p*-Value
Correct Score, Median (IQR)			
Septic Shock, Out of 5	3 (1)	4 (2)	.033*
COPD, Out of 5	4 (2)	4 (1)	.500
MI, Out of 7	4 (2)	6 (2)	<.001*
Asthma, Out of 5	3 (1)	4 (1)	.029*
Seizures, Out of 5	4 (1)	4 (1)	.726

IQR = interquartile range; MI = myocardial infarction.
* Significant at $p < .05$.

Strengths and Limitations

Limitations for this study included a small sample size due to the pilot nature of the study and that the study was conducted

Table 2 Within- and Between-Group Pre-Post Intervention CSE Comparison in the Treatment and Control Groups

	0.91					
	Pre—Post Treatment Difference (n = 23)		Pre—Post Control Difference (n = 20)		Pre—Post Difference in the Treatment and Control Groups	
Reliability of the CSE Scale	Mean (SD)	*p*-Value	Mean (SD)	*p*-Value	Mean (SD)	*p*-Value
Recognizing a Patient With No Pulse	8.04 (12.41)	.003*	2.45 (10.44)	.154	5.59 (11.54)	.060
Responding to a Patient With No Pulse	23.91 (17.38)	<.001*	−1.50 (18.57)	.639	25.41 (17.95)	<.001*
Recognizing a Patient That is Not Breathing	8.91 (16.44)	.008*	−0.50 (13.85)	.563	9.41 (15.30)	.025
Responding to a Patient That is Not Breathing	21.52 (17.28)	<.001*	−0.75 (19.62)	.567	22.27 (18.40)	<.001*
Recognizing a Patient With Dangerously Low Blood Pressure	8.48 (18.12)	.018*	−4.50 (15.12)	.900	12.98 (16.80)	.008*
Responding to a Patient with Dangerously Low Blood Pressure	18.48 (17.99)	<.001*	0.00 (17.77)	.500	18.48 (17.89)	.001*
Performing High-Quality CPR in an Adult Patient	14.78 (18.37)	.001*	−2.20 (18.96)	.695	16.98 (18.65)	.002*
Performing High-Quality CPR in a Paediatric Patient	13.91 (18.52)	.001*	2.25 (20.55)	.315	11.66 (19.49)	.029
Inserting an Oropharyngeal Airway and Using a Manual Resuscitation Bag in an Adult Patient	31.96 (24.11)	<.001*	3.00 (19.22)	.247	28.96 (21.98)	<.001*
Inserting an Oropharyngeal Airway and using a Manual Resuscitation Bag in a Paediatric Patient	31.52 (26.30)	<.001*	3.75 (21.08)	.218	27.77 (24.03)	<.001*
Responding to a Major Haemorrhage	28.26 (21.25)	<.001*	3.75 (17.46)	.175	24.51 (19.58)	<.001*

* Significant at $p < .05$ after adjusting for multiple comparisons.

at a single site. A recommendation to increase the rigour of this study if repeated would be to have the performances in the simulations be observed and rated using an interrater process to see if scores increased in relation to performance as well as the students reporting increase in self-efficacy.

Strengths of the study included the use of best practices in faculty preparation, scenario development, and debriefing practices.

Discussion

This study conforms with the literature by demonstrating that simulation can enhance knowledge after simulation intervention in recognition and response to the deteriorating patient (Buckley & Gordon, 2011; Kelly et al., 2014). In addition, a new clinical self-efficacy tool was developed and demonstrated a high reliability (0.91) in this study. More studies are needed to further understand the impact of the combination of virtual simulation and high-fidelity simulation in developing competency in caring for patients who are rapidly deteriorating.

Conclusions

Simulation can be an effective strategy for teaching recognition and response to the deteriorating patient among undergraduate nursing students. The additive effect and strategic timing of virtual simulation combined with high-fidelity simulation may be an important component in acceleration of mastery of competency in responding to the deteriorating patient. Further multisite research is needed with larger sample sizes to explore the use of simulation in the recognition and response to the deteriorating patient.

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