Research Paper

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A Comparison of The Effectiveness of Simulation-Based Versus Conventional Training Methods To Teach Patient Safety Competencies in Undergraduate Nursing Education

Nursing

KEYWORDS : Simulation – based & Conventional Teaching Methods, Nursing Education, Patient Safety Competencies

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ABSTRACT

The alarming rise in morbidity and mortality among hospitalized patients throughout the world increases concerns about health care professional competency. Nurses and other health care professionals are under increased pressure to provide safe and effective care. As a result, nursing programs are faced with increased demand to produce graduates capable of providing safe, efficient patient care. Toward that end, nursing education programs develop curricula, hire qualified faculty, and select learning experiences for students in an effort to train and graduate competent, effective nurses. The use of high fidelity simulation as an accepted substitute for traditional clinical learning experience over the past decade. However, little research evidence, in nursing, has documented the efficacy of these simulated learning experiences, particularly on objective outcomes such as examination performance. (Kohn & Corrigan & Donaldson, 2000) (Durham & Alden, 2008). Therefore this study was aimed to compare of the effectiveness of simulation – based to conventional training methods to teach patient safety competencies among students enrolled in critical care nursing course. Method: A randomized controlled design was used to conduct this study. One hundred students enrolled in the critical care course were included and randomly divided to two groups. Competency check lists with emphasizing on patient safety competencies were developed. Results: There was a statistically significant difference (P= 0.0001) between the two groups in relation to mastering the skills and attitudes related to patient safety. These differences were reflected in mean percent of knowledge, skills and attitude scores. Conclusions: It is necessary for simulation – based method to be fully integrated and used as a teaching method within nursing education programs at all stages. It is necessary to train the trainers through the development of a skilled faculty of expert clinical facilitators supported by adjunctive support staff in dedicated simulation suites.

Introduction:

Patient safety has been broadly conceptualized as the prevention of unnecessary patient harm or potential harm (Council of the European Union 2009 & WHO 2010). Educational preparation of students in the 21st century must be accomplished within a changing educational delivery environment. This educational preparation of nurses, may take on an even more challenging role since the health care environment is also changing at a pace that is often difficult to keep up with. The availability of appropriate hospital based clinical sites is diminishing, faculty shortages are projected to increase, and the need for additional nurses is increasing. In addition the students that faculty face in the 21st century is more technologically savvy and need educational opportunities that blend traditional pedagogy with technologically advanced pedagogical principles. One method of technologically advanced pedagogy, high-fidelity simulation, can meet some of these challenges in preparing undergraduate nursing students. (Kovalsky & Swanson, 2004)

High fidelity simulation refers to the artificial replication of the real world situation in which students work in order to gain knowledge and psychomotor skills to be able to critically think through complex scenarios in a safe and non-threatening environment. With increasing numbers of nursing students and decreasing numbers of available clinical sites, the use of high fidelity simulation has become an integral part of nursing education. With high fidelity simulation training, nursing students and practicing providers have the opportunity to develop and refine their skills using simulation technology without putting patients at risk. (Jeffries & Rogers, 2007) (Lamb, 2007)

Evidence about how patient safety is addressed in nursing curricula and how organizations develop safe nurses is limited. A gap currently exists in our knowledge about the extent and nature of the role of nursing education in patient safety improvement. There is also limited evidence evaluating what patient safety knowledge, skills and attitudes nurses require or how well nurses are prepared for their role in promoting patient safety. (Attree & Cooke & Wakefield, 2008)

In addition, a recent review of student mistakes supports the pressing need to systematically review how nursing program structures and processes may be contributing to student error and the undermining of patient safety. It is important, therefore, to investigate and describe how current nursing curricula incorporate themes of patient safety within practical and clinical training. (Gregory & Guse & Dick & Russell, 2007)

Materials and Methods

Setting:

The study was conducted at College of Nursing - University of Dammam since the college includes full access to a state-of-the-art simulation laboratory.

Research Design:

A randomized controlled trial of simulation based-teaching versus conventional training methods among critical care nursing students, using competency checklist evaluations was conducted.

Participants:

One hundred fourth year students enrolled in the critical care nursing course were included in this study. This group was divided randomly to two subgroups, each group composed of 50 students. Each subgroup was divided randomly again into 5 groups; 10 students per each group.

Tool:

A set of competency- procedure checklists were developed and previously reviewed and evaluated for content & face validity. Each checklist contained well-established procedure steps (AACN procedure manual for critical care 6th ed, 2014.) in conjunction with well emphasized patient safety competencies that were developed by the Canadian Patient Safety Institute (CPSI) Canadian safety competencies include 6 domains of patient safety and each domain contains steps reflecting the knowledge, skills and attitudes related to patient safety. (Frank & Brien on behalf of The Safety Competencies Steering Committee, 2008)

Procedure:

The study was composed of several phases:

Preparation phase:

1. Permission to conduct the study was obtained from the College Board after explanation of the aim and research methodology.
2. Informed consent was obtained from all students involved after explanation of the purpose, the method, and the duration of the study. Although a form of examination is used

during the study, it was not linked to any assessment strategy in the course. Students who fully participated in the study were rewarded with a certificate of attendance to enhance their professional portfolio.

3. A subject domain from the course syllabus was selected, the airway management module which ran for 18 hours/3 days plus 10 hours for OSCE was chosen. This module includes a set of clinical procedures included in a scenario about the clinical management of a patient with acute respiratory distress syndrome. These procedures include:
   - Patient Assessment
   - Patient positioning & insertion of Oropharyngeal air way
   - Assisting with ETT intubation
   - Performing Tracheal Suctioning
   - Drawing an arterial blood sample
   - Assisting with attaching the patient to mechanical ventilation
4. A time table for running the airway management module was established (attachement1)
5. Competency checklists (attachment2) were developed, reviewed & examined for their content and face validity. Each checklist contained key skills, and attitudes related to patient safety competencies represented on six domains which were;
   - Contribute to a culture of patient safety
   - Work in teams for patient safety
   - Communicate effectively for patient safety
   - Manage safety risks
   - Optimize human and environmental factors
   - Recognize respond to, and disclose adverse events
6. A four hour distributed on two lectures was prepared covering the theoretical background of the subject domain & patient safety competencies.

Implementation Phase:

Following approval of the College Board, the researchers recruited the students during a scheduled class. Students were provided with an explanation of the study prior to implementation, they then attended a 4 hours /2 lectures (30 minutes break between each of them) covering the theoretical background of the selected subject domain and patient safety competencies as they mentioned by Canadian Patient Safety Institute. After the initial lectures, students participating in the study were randomly divided into two groups. Half of the students were allocated to the control group (where conventional teaching method were used to teach the subject domain), whereas the other students were allocated to the experimental group (simulation – based method used to teach the subject domain). The two groups were again randomly divided in teams of 10 students.

Experimental Group (Simulation – Based Group)

Using SimMan 3G (High Fidelity Simulator, a computerized replica that simulates a real patient and is drug and hypoxia sensitive), a clinical scenario of patient with acute respiratory distress syndrome was adopted from the Program of Nursing Curriculum Integration (PNCI). Students from the experimental group were required to attend 14 hours simulation sessions. While one group was actively participated in the simulation session, the other four groups were acting as observers (each student was actively participated in 3 simulation sessions – 30 minutes per each session).All students were equally involved in the initial part of the session. The whole learning exercise could be jeopardized if students were not adequately briefed and prepared for the simulation. Only one instructor interacted with the patient simulator during any session. During the scenario students were expected to act as "qualified nurses" caring for the simulated patient. When required students received help from the facilitator who then took the role of either a doctor or a senior nurse. After having taken part in the scenario, students were debriefed using footage from the video tape recording. Students who were observing the scenario were invited to participate in the debriefing by sharing their views on aspects such as communication, situation awareness, teamwork, decision making, and clinical skills.

Control group (Conventional teaching method)

Five groups of Students (10 students in each group) were assigned to 5 instructors in the clinical skill laboratory. Each group spent 14 hours training on the above mentioned procedures related to airway management, each procedure was thoroughly explained by the instructor and then demonstrated and re-demonstrated as many times as deemed necessary (each student was asked to remonstrate each procedure 3 times during the training days). For this purpose the instructors used static manikins and task trainers designed to allow the students to practice the procedure safely until mastering it appropriately. Every attempt was made by the instructors to assist students in acquiring the necessary skills related to airway management.

Evaluation Phase: Objective Structured Clinical Evaluation (OSCE Session)

For the evaluation phase, the two groups were exposed simultaneously to an OSCE. The OSCE was conducted as a summative assessment in order to collect the data required for comparison between the two groups in relation to their adherence to patient safety competencies during their performance of the different procedures. The instructors making the OSCE stations were blinded to the group to which the students belonged (experimental or control). By comparing the results obtained by each group in the OSCE, it was possible to determine whether or not students from the experimental group had improved their safety related competencies by participating in the simulations. Competency checklists were modified and summarized to be appropriate with the time allocate to each OSCE station (10 minutes per station). All the key steps related to patient safety competencies were represented in the checklists without omission. Patient safety related competency that was concerned with knowledge was examined by post encounter MCQs. In each competency checklist, there was a separate paper containing 6 MCQs, each question was covered on the patient safety six domains.

Statistical analysis:

Data was coded, entered, & analyzed using statistical package SPSS version 19. Data was summarized using mean & standard deviation. Comparison between groups was done using independent sample t test. P value < 0.05 was considered statistically significant.

Results:

In the period between January and March 2012, 100 senior students enrolled in the critical care nursing course were recruited to the study. The students were randomly split to two groups; experimental group (50 students) and control group (50 students). Key knowledge, skills and attitudes related to patient safety competencies were scored in the competency checklist and analyzed by using of independent sample t test. There was a statistically significant difference (P= 0.0001) between the two groups regarding mean percent total score. The total score percent in both groups of the study was 89.9 for knowledge, 89.26 for skills and 88.64 for attitudes. There was a statistically significant difference (P= 0.0001) between both groups in mean percent knowledge, attitude and skills score. On comparing the two groups of the study regarding total percent score in the six domains of patient safety we found that there was a statistically significant difference (P= 0.0001) between experimental and control groups in mean percent scores of five out of the six studied domains of patient safety, namely; Domain (1) Contribution to a culture of patient safety, Domain (2) Working in teams for patient safety, Domain (3) Communicating effectively for patient safety, Domain (5) Optimizing human and environmental factors, Domain (6) Recognizing, responding to, and disclosing adverse events . However, in Domain (4); Managing safety risks there was no statistically significant difference between the two groups of the study (P= 0.062). There were strong positive correlations between total knowledge, skills and attitude scores (statistically highly significant: Pearson Correlation coefficient = 0.841)

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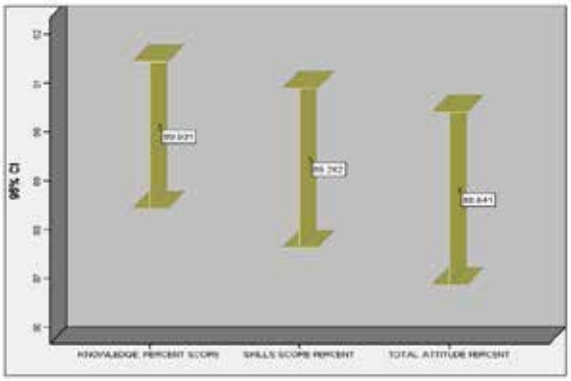

Figure (1): Total Knowledge, Skills & Attitude Scores in Both Groups the mean score percent was 91.62 for the simulation - based group and 84.96 for the conventional group. There was a statistically significant difference (P= 0.0001) between the two groups regarding mean percent total score.

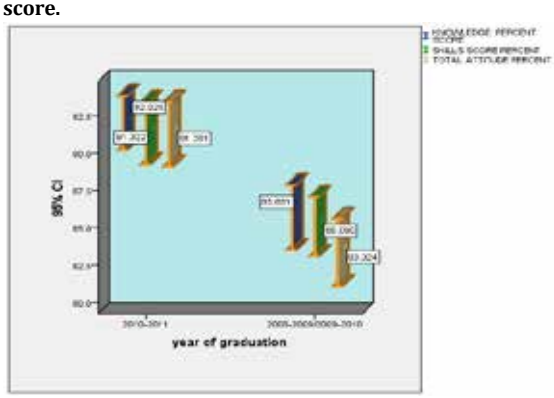

Figure (2): Comparison between Total Knowledge, Skills and Attitude Scores in Both Groups. There was a statistically significant difference (P= 0.0001) between the two groups regarding the mean percent total scores.

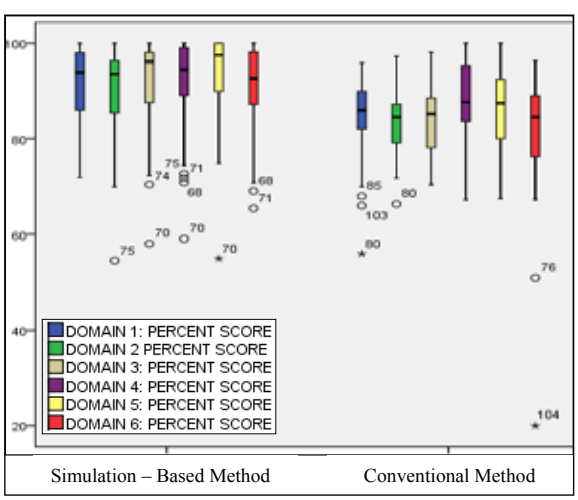

Figure (3) shows comparison between the Two Groups of the Study Regarding Total Percent Score in the Six Domains of Patient Safety Competencies. There was a statistically significant difference (P= 0.001) between interns and other graduates in mean percent score of five of the six studied domains of patient safety, namely; Domain (1) Contribution to a culture of patient safety, Domain (2) Working in teams for patient safety, Domain (3) Communicating effectively for patient safety, Domain (5) Optimizing human and environmental factors, Domain (6) Recognizing, responding to, and disclosing adverse events. However, in Domain (4); Managing safety risks there was no statistically significant difference between the two groups of the study (P= 0.062).

Table (2): Correlation between Total Knowledge, Total Skills and Total Attitude Scales:

		Total Skills Score	Total Attitude Scale
Total Knowledge Score	Pearson Correlation	.841(**)	.721(**)
	Sig. (2-tailed)	.000	.000
Total Skills Score	Pearson Correlation	1	.755(**)
	Sig. (2-tailed)		.000

There were strong positive correlations between total knowledge, skills and attitude scores (statistically highly significant).

Discussion

Whether or not to include simulation in an undergraduate nursing curriculum requires careful considerations with respect to the financial and physical feasibility, and the possible benefits to students. The use of high-fidelity simulation as an accepted substitute for traditional clinical learning experiences in nursing education has gained acceptance over the past decade. This acceptance can be evidenced by the results that have been reported by many studies who were interested in this field. (Ireland, 2008) (Jeffries, 2009) (Andreatta, 2011) (Benner & Sutphen & Leonard & Day, 2010) (Birch & Jones & Doyle & Green, 2007) (Brown & Rasmussen & Baldwin & Wyeth, 2012) (Buckley & Gordon, 2010). One more evidence was added to the previous evidences by performing the current study, in which the effectiveness of using high fidelity simulation to teach the undergraduate nursing students the concept of patient safety was studied. The finding of the current study revealed that, there was a statistically significant difference (p= 0.001) in mean scores regarding knowledge, skills & attitudes in 5 out of 6 domains of safety competencies between experimental group who teaching competencies were integrated in the different nursing scenarios & control group. On the same plate form, Hovancsek et al have reported that, patient safety has become a priority concern, and the use of simulators can prepare nurses for mock disasters that involve other professionals such as military, police, firefighter, paramedics, and physicians. The study found the demand for higher quality healthcare both nationally and internationally has increased and the use of simulation will improve health care. (Hovancsek & Jeffries & Escudero & Foulds & Huseb, 2009) Despite its obvious benefits of using high fidelity simulators, other researchers have been raised a question regarding its cost. Considering the high cost of high-fidelity manikin-based patient simulators compared to the more common manikins of lower fidelity, determining the impact of these devices on educational outcomes is critical in justifying their purchase and use. (Samuel & Tracy, 2011) (Mikkelsen & Reime & Harris, 2007)

Conclusions:

- Although the researchers of the current study supported the opinions of the other researchers regarding the financial cost required for purchasing, maintenance and training of the staff, financial costs are low compared to the potential cost of morbidity & mortality associated with the life-threatening event of graduation of an incompetent nurses.
- It is necessary for clinical simulation training to be fully integrated within training programs for nurses at all stages.
- It is necessary to train the trainers through the development of a skilled faculty of expert clinical facilitators supported by adjunctive support staff in dedicated simulation suites.

Recommendations:

To improve the graduates' capabilities to maintain and enhance patient safety through simulation training, the following recommendations should be emphasized:

- Full integration of high – fidelity simulation into the nursing curriculum. Weigh between the cost and benefit of integration.
- Create scenarios and *Simulated* Clinical Experience (SCE) stressing patient safety, prevention of errors, and promoting a culture of safety.
- Skill Competency Checklist should be tailored to cover the 6 domains of patient safety.

Attachment (1): Timetable of the Airway Management Module

Date / Time	Lecture	Assigned Group	Teaching Staff
First Day			
8:00 – 10:00	Airway Management	Both Groups	Dr. Radwa Hamdi
10:00 – 10:30	Break		
10:30 – 12:00	Patient Safety Competencies	Both Groups	Dr. Amina H. Salem
12:00 - 1:00	Prayer Time		
1:00 – 3:00	Demonstration & Re-demonstration of the Clinical Procedures	Control Group Is Distributed & assigned to Skill labs - Using Conventional Method (Task Trainer). Experimental Group Is Distributed & Assigned To Simulation Labs.	Each instructor will be assigned to each 10 students.
Second Day			
8:00 – 12:00	Demonstration & Re-demonstration of the Clinical Procedures For Both Groups (each student is assigned to demonstrate three times for each procedure).		
12:00 – 1:00	Prayer Time		
1:00 – 3:00	Demonstration & Re-demonstration of the Clinical Procedures For Both Groups		
Thrid Day			
8:00 – 12:00	Demonstration & Re-demonstration of the Clinical Procedures For Both Groups (each student is assigned to demonstrate three times for each procedure).		
12:00 – 1:00	Prayer Time		
1:00 – 3:00	Demonstration & Re-demonstration of the Clinical Procedures For Both Groups		
Fourth Day			
8:00 – 12:00	Objective Structured Clinical Examination (OSCE)		
12:00 – 1:00	Prayer Time		
1:00 – 4:00	Objective Structured Clinical Examination (OSCE)		
End of the Module (Rotation)			

Key Patient Safety Competency Domains* Conjugated with Key Steps of the Clinical Procedure – [Arterial Puncture - Procedure – Checklist]

Steps		ND (0)	DI (1)	DC (2)	NA
1.	Review the practitioner's order for laboratory tests required.	¾	¾	¾	¾
2.	Respect privacy and confidentiality	¾	¾	¾	¾
3.	Provide appropriate, sufficient and clear information, and teaching to patients	¾	¾	¾	¾
4.	Perform hand hygiene before patient contact.	¾	¾	¾	¾
5.	Verify the correct patient using two identifiers.	¾	¾	¾	¾
6.	Assess for factors that influence ABG measurements.	¾	¾	¾	¾
7.	Assess the patient's history for risks associated with arterial puncture before the procedure.	¾	¾	¾	¾
8.	Assess the patient for sites contraindicated for puncture.	¾	¾	¾	¾
9.	Review the patient's history for and inquire about signs of adverse responses to previous arterial puncture, including vagal or seizure response.	¾	¾	¾	¾
10.	Assess the patient's allergy history (e.g., local analgesia, antiseptic solutions, tape, latex, iodine).	¾	¾	¾	¾
11.	Assess the radial arteries.	¾	¾	¾	¾
12.	Ensure that labels and requisitions indicate the correct time the sample is to be drawn.	¾	¾	¾	¾
13.	Prepare the puncture site by applying an antiseptic and allowing it to dry completely.	¾	¾	¾	¾
14.	Perform the percutaneous puncture of the selected artery.	¾	¾	¾	¾
15.	Position the specific puncture site.	¾	¾	¾	¾
16.	Change to sterile gloves if the artery puncture site must be palpated after it is antiseptically prepared.	¾	¾	¾	¾
17.	Advance the needle until a flash of blood is seen in the hub of the syringe.	¾	¾	¾	¾
18.	Do not change the angle of the needle while the needle is deep under the skin because this could cause laceration of tissue, veins, muscle, nerves, and even periosteum.	¾	¾	¾	¾
19.	Obtain only the volume of blood required for analysis for ABG and ordered tests.	¾	¾	¾	¾
20.	Apply a sterile gauze pad over the puncture site while withdrawing the needle.	¾	¾	¾	¾
21.	Press the sterile gauze pad firmly over the puncture site until hemostasis is established. Observe for hematoma or bleeding.	¾	¾	¾	¾
22.	Explain investigations, treatments and protocols clearly and adequately to patients.	¾	¾	¾	¾
23.	Report to the practitioner if the patient does not achieve hemostasis.	¾	¾	¾	¾
24.	Once a safety guard is engaged, remove the needle and dispose of it in a sharps container.	¾	¾	¾	¾
25.	Once hemostasis is achieved, cover the puncture site with an adhesive bandage.	¾	¾	¾	¾

Steps		ND (0)	DI (1)	DC (2)	NA
26.	Prepare the specimens for the laboratory and transport per laboratory guidelines.	¾	¾	¾	¾
27.	Complete the required laboratory forms.	¾	¾	¾	¾
28.	Expedite the delivery of the sample to the laboratory, per laboratory requirements.	¾	¾	¾	¾
29.	Recognize and respond appropriately to potential and actual unsafe clinical situations.	¾	¾	¾	¾
30.	Assess, treat, and reassess pain.	¾	¾	¾	¾
31.	Discard supplies, remove PPE, and perform hand hygiene.	¾	¾	¾	¾
32.	Communicate the results with health care team.				
33.	Document the procedure in the patient's record.	¾	¾	¾	¾
Grade		¾	¾	¾	¾
Total Grade					

ND= Not Done, DI= Done Incomplete / Incorrect, DC= Done Complete / Correct, NA= Not Applicable

* Safety competency domains are merged with the steps of the clinical procedure, these domains include: Contribute to a Culture of Patient Safety, Work in Teams for Patient Safety, Communicate Effectively for Patient Safety, Manage Safety Risks, Optimize Human and Environmental Factors & Recognize, Respond to and Disclose Adverse Events.

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