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Abstract

Background

It is essential that nurses be prepared to provide quality care for patients with diabetes, a common condition today. The purpose of this study was to evaluate the impact of a high-fidelity simulation on traditional prelicensure nursing students' knowledge and performance related to care of the diabetic patient.

Methods

This multisite, multimeasure study used a purposive, quasiexperimental pretest-posttest design.

Results

Simulation positively impacted performance change scores. Pretest scores were positively associated with simulation scores and posttest scores.

Conclusions

The findings from this study support the use of high-fidelity simulation to improve care of the diabetic patient.

Keywords

diabetic care, nursing student, simulation, knowledge, student performance

Key Points

- Simulation in addition to classroom lecture had a positive association with learner outcomes.
- High pretest scores were positively associated with posttest scores.
- Participating in a simulation had a positive effect on perforce posttest scores.

Introduction or Background

Diabetes is a significant public health concern. According to the Centers for Disease Control and Prevention, 29.1 million people, or 9.3% of the U.S. population, have diabetes (Centers for Disease Control and Prevention, 2014). Given the prevalence of diabetes and its adverse health complications, it is essential that nurses be prepared to provide quality care for this population (Dunning, 2013). Nursing care for patients with diabetes includes ongoing glucose and electrolyte management, appropriate medication administration, and a thorough examination of the underlying cause of hyper/hypoglycemia to impact lifestyle changes.

Nurse educators use different teaching strategies to ensure that students are prepared to deliver safe and effective care to diabetic patients. Traditional methods follow a didactic structure where the delivery of content regarding specific disease processes is provided within a lecture format and clinical competencies are taught and assessed in skills laboratories and traditional clinical settings (National League for Nursing, 2004). In the last decade, the use of simulation to augment or replace traditional clinical experiences has increased in prelicensure nursing programs (Dunnington, 2014, Parker and

Myrick, 2009). Simulation allows students to participate in scenarios mimicking actual clinical situations in a safe and realistic environment (Bland et al., 2011, Ironside et al., 2009, Jeffries, 2005). The incorporation of simulation into the nursing curriculum ensures that all nursing students gain experience in providing care for high frequency, high-risk diagnoses, such as caring for the diabetic patient, before entry into practice (Benner, 2012). The use of simulation is associated with increased clinical reasoning, clinical judgment, critical thinking, problem solving, and psychomotor skill development in student nurses (Harder, 2010, Meakim et al., 2013, Wynn, 2011).

Several studies have demonstrated the efficacy of simulation in nursing diabetes education (Gibbs et al., 2014, Hudson et al., 2015, Tschannen et al., 2013, Yu et al., 2015). However, no studies have examined the effect of simulation in addition to lecture on students' knowledge and performance related to care of the hyperglycemic diabetic patient. Research examining the effect of simulation in addition to lecture in other high frequency diagnoses such as acute coronary syndrome and advanced cardiac life support, demonstrated significant improvements in knowledge gain (Elfrink et al., 2010, Hoadley, 2009, Zinsmaster and Vliem, 2016). The purpose of this study then was to examine the impact of a high-fidelity simulation experience on traditional pre-licensure nursing students' knowledge and performance related to key aspects of care of the diabetic patient. The research questions included were (1) Does participation in a high-fidelity simulation scenario after receiving didactic information influence nursing students' knowledge related to keys aspects of the care of the diabetic patient? (2) Does participation in a high-fidelity simulation scenario after receiving didactic information influence students' performance related to keys aspects of the care of the diabetic patient? (3) Is there a relationship between pretest scores, simulation scores, and post-test scores related to key aspects of the care of the diabetic patient?

Theoretical Framework

Kolb's Experiential Learning Theory (1984) served as the framework for this study. This theory includes four main concepts; concrete experience, reflective observation, abstract conceptualization, and active experimentation. Simulation provides students with experiential learning opportunities that align well with the theory's concepts. The concrete experience, represented by the simulation experience, allows the learner to engage in an actual patient care experience. Reflective observation, represented by the debriefing experience, allows students to reflect on their actions and observations during the simulation experience. During the abstract conceptualization phase, the students begin to generalize their actions to other patient care scenarios. Active experimentation allows students to apply the generalizations formed during the abstract conceptualization phase to new patient care experiences (Kolb, 1984).

Methods

Design

This multisite, multimeasure quasi-experimental pretest-post-test design with purposive sampling was used to examine the effect of simulation on nursing students' knowledge and performance in caring for a patient with diabetes. Subjects were recruited from three traditional undergraduate nursing programs in the Midwest. All programs had similar junior level course content using the same medical-surgical text book and comparable simulation experiences as part of their curriculum. The simulation

scenario used in the study was standardized by providing each instructor and simulation operator with guidelines including the objectives of the simulation, the patient scenario, scripting, supplies, and manikin fidelity with all sites using Laerdal SimMan 3G. At least one of the study investigators was present at each of the sites to ensure consistency among simulations.

Students were eligible to participate if they were in the third year of a traditional (four-year) nursing program and enrolled in their first medical-surgical nursing practicum course and associated theory course. A power analysis using the software R with the package simsem (Jorgensen, Pornprasertmanit, Miller, and Schoemann, 2017) was completed to determine the necessary sample size for this study (R Core Team, 2017). To detect a small effect (Cohen d = 0.2), a sample size of 190 participants was needed.

After institutional review board approval from each of the study sites, participants were recruited. While participation in simulation was a course requirement, by providing their consent, participants allowed the study investigators to evaluate their performance and include their scores in the study. To ensure confidentiality, a unique subject ID was used on study instruments.

Instruments

A demographic questionnaire, pretest, post-test, and simulation evaluation rubric were used in this study. The pretest and post-test were made up of 20 multiple-choice items developed for this study. This included ten test questions related to nursing skills that were expected to be demonstrated during the simulation ("performance items") and ten questions related to course content not directly related to the simulation scenario ("knowledge items"). Simulation performance was evaluated during the simulation using a 10-item evaluation rubric (Table 1) that corresponded with the "performance items" on pretest/post-test. Content validity of the pretest/post-test, simulation, and the simulation evaluation rubric were established by three nursing faculty who teach medical-surgical nursing and three Advanced Practice Nurses who work with endocrine or diabetic populations. Two study investigators completed all the simulation evaluations. The simulation evaluation rubric demonstrated acceptable interitem correlation estimates with Cronbach's alpha = 0.89. An adapted version of a pre-established simulation scenario developed by the National League for Nursing was used (National League for Nursing, 2018). The adapted version of the simulation scenario included an elevation in blood sugar, the patient exhibiting signs and symptoms of hyperglycemia, and insulin administration. The adapted scenario was validated before the study using the Laerdal scenario validation checklist.

Table 1. Simulation Performance Evaluation Rubric

Task Y = Demonstrates competency N = Does not demonstrates competency	**Y**	**N**	**Comments**
1. Handwashing/hand hygiene Washes hands for 15 seconds or uses hand sanitizer			
2. Complete patient teaching regarding normal glucose levels Verbalizes normal blood glucose levels			
3. Identify signs and symptoms of hyperglycemia States hyperglycemia s/s patient is exhibiting either to patient or during call to provider			
4. Identify need to contact the health care provider			

Contacts provider using situation, background, assessment, recommendation Must state patient name, situation, background, assessment finding (blood glucose, vitals, and s/s of hyperglycemia), and recommendation			
5. Identify correct patient Asks patient for name and DOB and reviews name band			
6. Able to use and understand sliding scale insulin Able to state the correct amount of NovoLog insulin being drawn up (14 units)			
7. Able to calculate the correct dose of insulin to administer Able to state the correct amount of NovoLog insulin and NPH insulin to be drawn up (14 units of NovoLog, 12 units of NPH)			
8. Able to correctly draw up insulin Able to draw the correct amount of NovoLog insulin and NPH insulin in the correct syringe (14 units of NovoLog, 12 units of NPH in an insulin syringe = 26 units total)			
9. Able to administer medication subcutaneously Administers correctly (45°-90° subcutaneously in either the thigh, abdomen, or upper arm)			
10. Patient teaching: Able to describe the signs and symptoms of hyperglycemia Completes a teaching session with patient who includes the signs and symptoms of hyperglycemia			

Total score: _____/10.

NPH, neutral protamine Hagedorn insulin.

Procedure

Students from all three sites received similar didactic course content regarding the care of diabetic patients with hyperglycemia and hypoglycemia, which included information from the same text book. After the didactic portion of the course, participants completed the demographic questionnaire and the 20-item pretest. Simulation preparatory materials including the simulation objectives, laboratory values, a medication administration record, and a nurse report with assessment findings were provided to participants after completion of the pretest via an electronic link. The simulation objectives included were as follows: (l) Perform a focused assessment for a patient with type I diabetes, (2) analyze laboratory values and determine appropriate actions, (3) demonstrate appropriate decision-making skills in care of the diabetic client, (4) interpret assessment findings related to patient condition and collaborate appropriately with team members to manage problems, (5) perform safe nursing interventions, and (6) perform safe medication administration. Participants took part in a simulation scenario involving the care of a patient exhibiting signs and symptoms of hyperglycemia.

Students participated in the simulation in pairs, but their performance was assessed separately by a trained research assistant using the simulation evaluation rubric. All simulations were recorded. Most simulations were viewed in person by the research assistant with the ability to review the recorded

simulation when needed. Maximum time allotted to complete the simulation was 20 minutes. Immediately after the simulation and debriefing, participants completed the 20-item post-test.

Analysis

Descriptive statistics were used to summarize demographic characteristics of the sample, pretest/post-test scores, and simulation scores. Change scores were calculated for the total pretest/post-test scores and for the "performance" and "knowledge" subsets with a positive value indicating improvement. Pearson's correlations were used to examine associations between pretest, simulation, and post-test scores. R was used to conduct the analysis (R Core Team, 2017). The homogeneity between sites was compared through an analysis of variance with heterogeneous variances between sites. There are no meaningful mean differences between sites (p = .13); while looking at variance comparison there are no meaningful differences between sites (p = .65). This if further shown by this group comparison explains 1.6% of the variance in the total score, which represents a negligible effect.

Two hundred thirty-three students participated in the study with a mean age of 21.07 years. Most participants were female (N = 218, 93.6%) and Caucasian (N = 204, 87.6%). There were no significant differences in demographic variables across the three sites.

Results

First, the effect of simulation on participants' knowledge and performance related to care of the diabetic patient was examined (Table 2). Simulation did not have a significant effect on total change scores (p = .147) or knowledge change scores (p = .137). However, simulation did have a significant positive effect on performance change scores (p < .001; r = 0.28). The mean pretest score on performance items was 0.73 (SD = 0.14), and the mean post-test score on performance items was 0.76 (SD = 0.12). Next, the association between the pretest, simulation, and posttest scores was explored (Table 3). Pretest and posttest scores were positively associated (r = 0.656) with very large effect sizes. There was also a positive association between pretest and simulation scores (r = 0.196) with a small effect size as well as simulation and post-test scores (r = 0.280) with a medium effect size.

Table 2. Change Scores

Score	**Pre-mean % (SD)**	**Post-mean % (SD)**	**Change score mean (SE)**	***p*-value**	**Cohen d**
Total	69 (13)	70 (12)	0.011 (0.007)	.143	0.096
Performance	73 (14)	76 (12)	0.039 (0.009)	<0.001*	0.280
Knowledge	66 (18)	64 (17)	−0.017 (0.011)	.137	−0.097

*p < 0.05.

Table 3. Correlations

Items	**Total Pre**	**Perf Pre**	**Know Pre**	**Total Post**	**Perf Post**	**Know Post**	**Simulation**
Total pre	1						
Perf pre	.727*	1					
Know pre	.861*	.278*	1				

Total post	.656∗	.328∗	.549∗	1			
Perf post	.432∗	.431∗	.286∗	.680∗	1		
Know post	.447∗	.131∗	.530∗	.853∗	.199∗	1	
Simulation	.196∗	.121∗	.183∗	.280∗	.128∗	.282∗	1

Note. Perf, performance; Know, knowledge.
∗$p < 0.05$.

Discussion

In this study, simulation in addition to classroom lecture had a positive effect on students' performance related to key aspects of the care of the patient with hyperglycemia. Prior studies have examined the effect of simulation on educational outcomes and also observed significant improvements in both knowledge and performance (Mariani et al., 2017, Rholdon et al., 2018). On the other hand, Skinner (2017) observed no significant change in students' knowledge regarding the care of community-dwelling patients after a community-focused simulation. Moreover, significant improvements in the performance test items that were specifically related to the simulation scenario were found in the present study. This suggests that students retained information regarding the skills they performed during the simulation.

Other studies have also reported improvements in nursing students' skill performance after simulation (Hart, Maquire, Brannan, Long Robley, and Brooks, 2004; Mariani et al., 2017, Rholdon et al., 2018). However, no significant improvements were observed in the knowledge items, which may be related to the educational level of the participants as this was new content for most of them. Although the objectives for this simulation were focused on decision-making, students were required to perform many skills and may have perceived this to be a key aspect of the experience.

The strong association between pretest and post-test scores suggests that students who did well on the pretest were more likely to perform well on the post-test. This is not surprising as they clearly had a better understanding of the material. Moreover, students with a higher baseline understanding of the content related to care of patients with hyperglycemia and hypoglycemia were more likely to perform better in the simulation, demonstrating that their knowledge was able to be applied to patient care. While this is again not surprising, it validates the importance of providing students with opportunities to apply what they are learning in the classroom and how simulation can be used for this purpose. Future studies could explore potential correlations between lower performing students' performance and knowledge gains after simulation experiences to determine whether they had a similar outcome as high performing students.

Limitations

This study had several limitations. The time between when the content was delivered in the didactic environment and demonstrated in the simulation may have affected student's performance and knowledge recall. Although every effort was made to standardize study procedures across participating colleges, nuanced differences between simulation operators, such as voice inflection of verbal simulation cues, may have contributed to variation in student's performance. In addition, students completed the pretest/post-test individually, but the simulation was completed in pairs, which may

have resulted in better performance as students could think and make decisions with the input of their partner. This limited the ability to examine the true effect of simulation on change scores, however, as such, the small but significant effect on performance scores is notable.

Conclusion

This study, focused specifically on diabetic care, corroborates other studies investigating educating nurses to care for patients with specific disease processes by using a didactic plus simulation strategy. It provides further evidence that simulation, in addition to didactic course content, improves students' performance and application of what they are learning in class into patient care. The study's findings add to the body of knowledge supporting the use of high-fidelity simulation in traditional undergraduate nursing programs. More research is needed to examine the impact of simulation in addition to didactic content on postgraduate nursing practice and safe, quality patient care.

Supplementary data

Download : **Download XML file (259B)**

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