SIMULATION IN NURSING EDUCATION: A LITERATURE REVIEW

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ABSTRACT

The use of simulation is not a novel concept in nursing education. As early as the first two decades of 20th century, the educational preparation of future nurses has involved simulation-based experiences. Current practice in health care and nursing promotes the incorporation of evidence to guide professional decisions and practice. A review of literature and studies is undertaken to explore simulation in nursing education, as well as examine the available evidence to support its continued use as a pedagogical modality or tool in undergraduate nursing programs.

Keywords: *simulation, learning, undergraduate nursing education, student nurses*

INTRODUCTION

Various teaching techniques are employed in undergraduate nursing programs to facilitate the acquisition of professional knowledge and clinical skills among student nurses. In one journal article, Grypma (2012) recalled a mannequin named "Mrs. Chase" that was utilized in her nursing education in the 1980s to support student learning. This life-sized human model was first introduced in the Hartford Hospital Training School for Nurses in 1911 (Herrmann, 2008; Hiestand, 2000; Hyland & Hawkins, 2009; Nelson, 2016). From the past to the present, Mrs. Chase has remained an invaluable training tool because it enables student nurses to demonstrate newly-learned skills without posing any risks to real patients (Grypma, 2012).

Mrs. Chase, a static and low-fidelity human replica (Hyland & Hawkins, 2009), is just one form of instructional tool in a simulation-based learning. For many decades, skills training of student nurses in the academe involves diverse simulation strategies (Kardong-Edgren, Starkweather, & Ward, 2008). The wide variety of simulators in nursing, as described by Nehring and Lashley (2009), includes the "anatomical models, task trainers, role playing, games, computer-assisted instruction (CAI), standardized patients, virtual reality, and low-fidelity to high-fidelity mannequins" (p. 528).

Simulation technology is commonly assumed to benefit teaching and learning (Alinier, Hunt, Gordon, & Harwood, 2006). For Alinier, Hunt, and Gordon (2004), it enables understanding and application of nursing knowledge and technical skills among student nurses. However, Cordeau (2010) viewed simulation in undergraduate nursing programs as addressing the three domains of learning: cognitive, psychomotor, and affective. And to restrict one's evaluation on only one learning aspect, according to Kardong-Edgren, Adamson, and Fitzgerald, (2010) is tantamount to painting an incomplete picture of overall student performance. In that regard, this literature review explores previous works on simulation and its impact on different domains of learning.

The phrase “simulation in nursing education” was used to search for simulation literature in the Cumulative Index to Nursing and Allied Health Literature (CINAHL) Plus database, which produced 97 matches. Out of this number, 34 titles were readily excluded either because of full-text unavailability or deemed inappropriateness of participants for this endeavor (e.g., graduate nurses, practicing nurses, midwifery students). On the other hand, the 63 titles that appeared as studies related to nursing simulation in undergraduate programs were identified as potential references. An ancestry search, or the skimming of the citation section of selected works, was undertaken to look for additional sources of literature. While most journal articles were accessed from the CINAHL Plus or websites of respective journals, some of titles were obtained through interlibrary loan or Yahoo or Google search. Through careful reading of all retrieved full-texts, these published works are classified as six primary references for literature review (i.e., research or study) and the rest are supporting literature (e.g., meta-analysis, literature review, general articles, etc.) to better understand nursing simulation.

TOWARD AN UNDERSTANDING OF SIMULATION

Simulation is an imitation of a clinical reality or healthcare scenario. It involves patient models, softwares, role-playing, or games (Sleeper & Thompson, 2008). Contrary to the popular notion of simulation as a technology, it is rather a technique to "replace or amplify real experiences with guided experiences, often immersive in nature, that evoke or replicate substantial aspects of the real world in a fully interactive fashion" (Gaba, 2007, p. 126). Such description clarifies that simulation can only mirror reality. Nonetheless, it also implies the critical contribution required of educators in the design of learning experiences in the simulation laboratory (sim lab) and attainment of optimal student outcomes.

Kneebone (2005) conceptualized the effectiveness of medical simulation as a pedagogical strategy in four overarching themes: (a) proficiency in clinical skills, (b) task-mastery through judicious assistance by faculty, (c) contextual or situated learning, and (d) integration of affective content of learning. Cant and Cooper (2010) recognized the applicability of these theoretical propositions to nursing education.

SIMULATION IN NURSING EDUCATION

As previously emphasized, simulation in undergraduate nursing programs encompasses cognitive, psychomotor, and affective learning (Cordeau, 2010). Soliman, Sheble, and Shrief (2014) go so far as to assert that the semblance of reality in simulation pedagogy results from the integration of all three learning dimensions. While the cognitive domain seems lacking in Kneebone's conceptualization, it is helpful to take note that the "theory of skills acquisition is dominated by cognitive issues..." (Kneebone, 2005, p. 551). This kind of theoretical understanding indicates thatawareness of concepts and learning materials is necessary to master procedural competencies. The cognitive aspect, then, is assumed in the successful achievement of psychomotor-related objectives. Whether geared towards formative assessment or summative evaluation (Edgecombe et al., 2013; Hovancsek, 2007), simulation in nursing programs may take the form of introducing students to nursing procedures as basic as handwashing, and progressing to skills as complex as clinical reasoning and professional judgment throughout the course of study (Hope, Garside, & Prescott, 2011).

PATIENT SAFETY AND SIMULATION

Although nursing history proves that simulation is not really a novelty in the training of student nurses, unprecedented changes in the healthcare environment paved the way for its newfound popularity. Alinier and his colleagues (2006), for instance, ascribed the demand for newer instructional tools to the growing appreciation of the utility of modern medical technology, as well as higher consumer expectations for care. Other implicated reasons for incorporation of simulation in nursing programs include shortage of nursing instructors, shortened length of hospitalization, closure of some hospitals (McNeal, 2010), inadequate time with preceptors, and relative lack of clinical placements secondary to increased volume of students nurses (Kilmon, Brown, Ghosh, & Mikitiuk, 2010). What follows then is a learning situation for student nurses that McNeal described as devoid of relevant clinical experiences. Underlying most of these factors is the welfare of the general population, whom Gaba (2007) noted as the primary impetus for the current revolution in health professions education. In practice, nurses are ethically obligated to do good (beneficence), do no harm (non-maleficence), and in the process, deliver safe and effective care of patients. These ethical imperatives are in essence realized byprioritizing care and safety of patients at all times.

Berragan (2011) acknowledged that patient safety concerns, time constraint, and cost-efficiency measures - not to mention work-related stress and potential lawsuits in clinical areas - hinder the assimilation of clinical skills. Thus, it is necessary to consider effective strategies for teaching and learning in nursing. One solution is the simulation modality that has been successfully used in aviation and transportation industries. Simulation-based instruction affords student nurses the opportunity to acquire or develop clinical skills and perform real procedures more than once in a safe, controlled environment without involving living patients (Nelson, 2016). In a sim lab, for instance, it is possible to administer medication to more advanced patient simulator and observe physiologic responses on the bedside monitor. Not surprisingly, the Institute of Medicine (IOM) included simulation training as one of the recommendations for developing a supportive learning environment for healthcare professionals (Kohn, Corrigan, & Donaldson, 2000).

EVIDENCE-BASED NURSING EDUCATION AND SIMULATION

Since the last decade of the 20th century, there has been a strong emphasis on best evidence to inform healthcare practice. From an initial focus on hospitals, evidence-based practice (EBP) also found its way to the nursing academia. As early as 2002, the National League for Nursing (NLN) has asserted that nursing instruction "must be evidence-based, with research informing what is taught, how learning is facilitated and evaluated, and how curricula/programs are designed" (p. 3). In this NLN position statement, one should be careful not to conceive research as pertaining exclusively to clinical trials as the nursing profession recognizes qualitative sources of knowledge, too. In fact, Carper (1978) and White (1995) identified that there are five ways of knowing in nursing, which include empirical (scientific), esthetic (artistic), ethical (moral), sociopolitical (contextual), and personal (individual) knowing. So, evidence in nursing is not restricted to that information solely obtained from clinical trials. Such non-exclusive view of evidence is captured in the definition of EBP as applied to nursing education by Ferguson and Day (2005), expressing that it is the reliance on research data to "justify particular teaching or curricular interventions, considering the needs of individual learners, the professional judgment of nurse educators, and the resource costs of the interventions" (p. 110).

GROUNDING UNDERGRADUATE NURSING SIMULATION IN EVIDENCE

The incorporation of lifelike patient models, or human patient simulation, in undergraduate nursing programs requires financial investment and time commitment from nursing educators (Shinnick, Woo, & Evangelista, 2012). To justify clinical simulation in the training of student nurses, nursing professionals in certain parts of the world explored its benefits as a teaching modality in nursing education.

SIMULATION STUDY IN THE UNITED KINGDOM

Alinier and colleagues (2004) evaluated the role of simulation in terms of competence and confidence among nursing sophomores of the University of Hertfordshire. Participating students who volunteered to take part in the study were randomized into two groups: the control group and the experimental or simulation group. Both groups underwent competence assessment of communication and clinical skills through an Objective Structured Clinical Examination (OSCE) at the beginning of the study (pretest) and six months later (post-test). The OSCE consisted of eleven practical skills stations and four theoretical stations. Their level of confidence was assessed using a five-point Likert scale in the confidence questionnaire, which was filled up by the participants just prior to the start of the second OSCE. After the baseline competency determination, 38 students allocated to the control group followed the traditional clinical placement of the school. On the other hand, 29 students from the simulation group experienced two simulation sessions, which involved orientation to the sim lab and interaction with the patient simulator, followed by a debriefing conference for feedback and reflection.

After data collection and analysis, Alinier et al. (2004) found no significant difference in the perceived confidence level of the control (3.5/5) and simulation (3.48/5) groups. In addition, the research data showed the comparability of baseline competence between two groups (control group 49.59% vs. simulation group 50.19%), as well as the subsequent increase in competence scores of both groups on the second OSCE (control group 56.35% vs. simulation group 63.62%). Alinier and colleagues, however, highlighted the 6.67% difference between the final OSCE scores of both groups, which approached statistical significance ($p < 0.05$) and favored the simulation group.

In another study, Alinier and colleagues (2006) further investigated the role of simulation in the training of student nurses using a comparable pretest/post-test design and measurement technique from the previous study. Out of the 99 participating sophomores, 50 were randomly assigned to the control group and 49 to the simulation group. Initial OSCE scores were comparable between groups: control group 48.82% and simulation group 47.54%. While both groups obtained increased scores on the second OSCE (control group 56% and simulation group 61.71%), the 7% difference between the two scores was highly significant ($p < 0.001$) in favor of the simulation group. Similar to the result of the earlier study, there was also no significant difference in the reported level of confidence between the control (3.5/5) and simulation (3.4/5) groups.

While the simulation experience provided the simulation groups more in both studies exposure to the sim lab and supplementary clinical practice, Alinier and colleagues (2004, 2006) contended that those sessions in no way prepared participants for the last competence assessment of communication and clinical skills. But it may be difficult to dismiss the idea that the significantly higher OSCE scores on second evaluation of the simulation groups against the control groups may be attributed to the former's added familiarity to the sim lab and its equipment. It is possible that the simulation sessions worked for the benefit of the simulation groups. And it also should be noted that out of the 15 OSCE stations, 11 were dedicated to evaluation of psychomotor skills that the simulation groups probably encountered during the simulation.

In view of the results of the two studies, Alinier et al. (2004, 2006) concluded that nursing simulation is a valuable modality for nursing education.

SIMULATION STUDY IN EGYPT

A pretest/post-test simulation study in Egypt by Soliman et al. (2014) included 260 nursing freshmen at the Mansoura University. Out of the total participants, 131 were randomly assigned to the control group and 129 to the simulation group. Instead of 15 stations, the study introduced a 10-station OSCE for the cognitive and psychomotor evaluation of the participants. The researchers reported a significant difference in baseline OSCE ratings between the two groups (control group 13.57 vs. simulation group 12.49; $p < 0.004$). Four months later, both groups scored significantly higher than their initial competence assessment marks (control group 14.27, $p< 0.001$; study group 17.33, $p< 0.001$). However, between-groups comparison of second OSCE results revealed a highly significant difference ($p < 0.001$) in favor of the simulation group. According to Soliman and colleagues, the findings suggest a "positive effect of simulation on clinical performance" (p. 389). Such suggestion should not be construed as pertaining to improvement in clinical competence in real healthcare situations. Rather, the impact of simulation on the "clinical performance" of participants should be understood as gains in knowledge and/or skills at best, as measured by OSCE in the school setting.

SIMULATION STUDY IN THE UNITED STATES OF AMERICA

In 2006, Jeffries and Rizzolo reported the result of the NLN-sponsored multi-phase simulation study that involved different sites in several American States. In the Phase III of the study, 403 nursing students were randomized into three groups: (1) paper/pencil simulation group, (2) static mannequin simulation group, and (3) advanced lifelike patient simulation group. Students from the three simulation groups answered a 12-item pretest at the beginning of the study, and watched a standardized video lecture on the nursing care of a postoperative patient.

While Jeffries and Rizzolo (2006) described a uniform simulation scenario for all groups, the paper/pencil simulation group worked on replying to case scenario questions or problems. The other two groups participated in a hands-on simulation: one group using the static mannequin and the other using advanced lifelike simulator. After the simulation activity, all groups attended the debriefing conference with an instructor. Outcome measures for the study were knowledge (two-item multiple choice test), self-rated confidence level (scale), perceived performance (scale), and simulation satisfaction (scale). The summary of Phase III findings are as follows:

(a) knowledge - highly significant difference between pretest/post-test scores ($p< 0.0001$)
- no significant difference on post-test scores among the three groups

(b) self-rated confidence level - significantly greater level of confidence on hands-on simulation groups (static mannequin and advanced lifelike simulator) versus paper-pen simulation group

(c) perceived performance - no significant difference among the three groups in terms of personal evaluation of their performance during simulation

(d) simulation satisfaction - significantly higher satisfaction level among students from advanced lifelike simulator (Jeffries & Rizzolo, 2006).

With regard to comparability of post-test scores among the three simulation groups, Jeffries and Rizzolo (2006) dismissed it as unsurprising. Rather, they argued that the desiredcognitive outcomeduring simulation should be more on knowledge synthesis and application. Considering the two-item post-simulation test taken by the participants during Phase III, it is highly unlikely that those higher levels of cognition were adequately measured in the study.

Quite interestingly, the Jeffries and Rizzolo (2006) did not include a control or non-simulation group in its nationwide study. The lack of control group in the

NLN study is probably its limitation. Thus, it is impossible to determine any advantage of nursing simulation over traditional clinical placements.

In a separate study, Shinnick et al. (2012) probed whether or not simulation can lead to quantitative gains in heart failure knowledge among 162 junior students from three nursing schools in Los Angeles. The same study also sought to determine if there were factors that promote new knowledge acquisition. Allocation of the convenience sample to either the control or simulation group was achieved through block randomization: student nurses attending the school in one particular day were assigned to the control group (n = 72), and another set of student nurses the next day was allocated to the simulation group (n = 90). Participating students received heart failure lecture in their respective schools, as part of the nursing program. Members of both groups completed a parallel before-and-after multiple choice test (12 items). Baseline knowledge of students was established using the pretest. The simulation group took the post-test after the simulation scenario involving an advanced lifelike patient model. On the other hand, the control group wrote the post-test before the scheduled clinical simulation.

Shinnick et al. (2012) reported higher post-test scores in the simulation group in relation to the control group. Despite the increased scores, only 25% of students from the simulation group obtained a mark of at least 10 points (> 80%), which was the established 'good' score in the study. Thus, the researchers mentioned the possibility of other unexplored student factors (e.g., knowledge retention, baseline grades) to account for such high scores. Perhaps, those students were good to start with. On the other hand, Shinnick and colleagues also reported that variables such as student age, learning preference, and critical thinking were not significant predictors of improved heart failure knowledge.

Due to inadequacy of research evidence to make an informed decision on several requests from many nursing schools to consider simulation experience as substitute for actual clinical hours, the National Council of State Boards of Nursing (NCSBN) tasked Hayden, Smiley, Alexander, Kardong-Edgren, and Jeffries (2014) to conduct the NCSBN simulation study. A total of 666 nursing students from 10 American schools who participated in the study were randomly allocated to one of the three groups: (a) control group (90% traditional clinical placements plus 10% simulation experience), (b) simulation group (75% traditional clinical placements plus 25% simulation experience), and (c) simulation group (50% traditional clinical placements plus 50% simulation experience) and followed throughout their nursing education and first six months of employment. Outcome parameters for the study included undergraduate nursing knowledge, NCLEX-RN pass rate, clinical competency as a nursing student, and clinical competency-practice readiness as a novice nurse. The results are summarized as follows:

(a) undergraduate nursing knowledge - no significant difference (p = 0.478) among three groups
(b) NCLEX-RN pass rate - no significant difference (p = 0.737) among three groups
(c) undergraduate clinical competence - no significant difference (p= 0.688) as rated by preceptors among three groups

(d) clinical competence-practice readiness as a novice nurse - no significant differences on the first six weeks (p = 0.706), first three months (p = 0.511), and first six months (p = 0.527) of employment among three groups (Hayden et al., 2014).

Based on research findings, Hayden et al., (2014) concluded that the traditional clinical hours in undergraduate nursing programs can be replaced by as much as 50% of quality experiences in the sim lab. This conclusion is perhaps best understood in the context of the study. In the discussion of study limitations, the NCSBN researchers admitted the lack of randomization with regard to selection of nursing schools from which participants were recruited. It is also acknowledged by Hayden and colleagues that the participating schools "had a simulation laboratory and the equipment" for the large volume of necessary simulation sessions in contrast to other schools that may not be ready to "begin or increase their simulation programs with the aggressive level of simulation" required for the study (p. S36). In that respect, it is important to consider if the allowed 50% of simulation in lieu of actual practice hours must only apply to students from schools with comparable sim lab and resources to the 10 selected schools in the NCSBN study.

CONCLUSION

In the simulation studies included in this literature review, it appears that the affective domain is not directly addressed or included as an outcome parameter. Instead, these studies focus on components that are relatively easier to measure. But to appropriately justify the use of simulation in nursing education, it is necessary to explore its advantages in all aspects of academic learning. Kardong-Edgren et al. (2010) emphasized the incomplete caricature of student performance that results when academic evaluation is limited to just a single domain. Learning outcomes of simulation need to be appraised in its totality.

In light of the studies and other simulation-related articles reviewed, simulation can only substitute for actual patient interaction or clinical experience up to a certain extent. Simulation, as the term means, can only suggest reality. Despite its verisimilitude, it is still not real. It is devoid of genuine experiences related to human responses to health, sickness, and healing. Encounters with patient simulator do not provide student nurses the opportunity to empathize with patients or their loved ones. Rather, it is from true patient-care situations that student nurses learn the intangible aspects of nursing as caring. So, while simulation proves to be beneficial to student learning in one way or the other, it can not completely replace authentic clinical experiences that allow students nurses to interact with living persons.

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