

Review Article

High Fidelity Simulation in Nursing Education

Melba Sheila D'Souza¹, Porkodi Arjunan², Ramesh Venkatesaperumal¹

¹Adult Health and Critical Care, College of Nursing, Sultan Qaboos University, Muscat, Sultanate of Oman,

²College of Nursing, Sri Ramachandra University, Porur, Chennai, Tamilnadu,

Corresponding Author: Melba Sheila D'Souza

ABSTRACT

Aim: This paper reviews the use of high fidelity simulation (HFS) in nursing education.

Methods: An integrative review was used to assess the effectiveness of high fidelity simulation in nursing education. Data search was between 2007 to 2016 using CINAHL, Cochrane, EMBASE, ERIC, MEDLINE, Ovid, Proquest, PsycINFO, Scopus, SciVal, Web of Science, Joanna Briggs Institute and EBSCO host. A total 45 articles met the eligibility criteria.

Discussion: Themes materialised were: learning in a safe, supportive and simulated environment, self-satisfaction and confidence, critical thinking and clinical reasoning, clinical decision-making and clinical judgement, knowledge retention and gain, skill acquisition and performance, interprofessional collaborative practice and nursing care, teamwork and communication, development of cognitive, psychomotor and behavioural skills.

Conclusion: HFS provides diverse learning experiences, promotes decision-making and skill acquisition to develop assessment and safe practice.

Implication: Nurse educators can create a variety of patient conditions for collaborative nursing care for increasing learning outcomes.

Key words: high fidelity simulation, technology, learning outcomes, students, nursing education

Highlights

HFS contributes to diverse learning experiences, knowledge retention and skill acquisition in a safe and supportive environment.

HFS improves the quality of learning, organization of care, team work and promotion of clinical decision-making.

HFS nurtures and develops cognitive, psychomotor and behavioural skills for interprofessional collaborative practice.

INTRODUCTION

Nursing practice is intellectually and emotionally challenging because it requires quick judgments and responses to life-threatening conditions. Nursing students experience 'reality shock' while learning in the clinical environments. Advanced technology like e-learning is used for improving active learning, participation and communication with students (D'Souza et al., 2014). It helps student engagement in active learning, faculty-student interaction

and diverse experiences (D'Souza et al., 2013). Simulation is defined as a pedagogy used to promote a student's progression from novice to expert (Meakim et al., 2013, p.9).

High-fidelity human patient simulation (HFS) is the distinct use of computerised manikins, virtual simulation or standardized patients in life-like safe realistic nursing simulated scenarios (Hinchcliffe-Duphily, 2014; Phillips, 2011). HFS bridges the use of technology for learning experiences and guided reflection

in a safe realistic nursing environment. HFS may improve students' thinking, emotional, decision-making abilities (Wotton, Davis, Button & Kelton, 2010), knowledge and understanding (Gates, Parr & Hughen, 2012; Partin, Payne & Slemmons, 2011; Weaver, 2011). HFS provides an interactive, participating learning environment (Powell-Laney, Keen, & Hall, 2012; Sideras et al., 2013) and reinforce knowledge, clinical skill acquisition (DeBourgh & Prion, 2011). HFS increases clinical judgement (Cato, 2012; Hayden, Smiley, Alexander, Kardong-Edgren & Jeffries, 2014; Thomas, McIntosh & Allen, 2014) and builds self-confidence (Aerbersol & Tschannen, 2013; Jeffries & Rogers, 2012; Oldenburg, Brandt, Maney & Selig, 2012).

HFS is skilled to replicate physiological response and is useful for effective learning (Lewis et al., 2012; Shearer, 2013) and performance (Powell-Laney et al., 2012; Bogossian et al., 2014) in complex patient scenarios (Garrett et al., 2011). HFS focus on the specific contextual and conceptual areas to advance problem-solving and critical thinking skills among novice students to become expert nurses (Institute of Medicine, 2010). HFS develops skill competencies (Whyte et al., 2012) and contributes to cognitive and psychomotor outcomes (Liaw, Scherpbier, Rethans, & Klainin-Yobas, 2012). It improves patient safety (Brady, 2011; Handwerker, 2012) by improving critical thinking, validate information, clinical judgement. Student's engagement in meaningful processes, participation and focused attention improves clinical reasoning, learning for understanding and conceptualizing (D'Souza, Isac, et al., 2014). Hence novice nurses have an advantage point through observation, identification and prioritization of concepts or care for improved learning outcomes.

Aim

This paper aims to identify the best evidence on the effectiveness of using high fidelity simulation technology for learning outcomes in nursing education.

METHOD

An integrative review was used to assess the best evidence on the effectiveness of high fidelity simulation technology and learning outcomes in nursing education.

Inclusion criteria

Type of participants

The review includes HFS used in the undergraduate nursing students. Studies including other health care professionals were excluded.

Type of intervention

The intervention is the use of high fidelity patient simulation technology in nursing education.

Type of outcome

The primary outcome are learning outcomes like satisfaction, confidence, cognitive, conative and affective in nursing education as assessed by validated and reliable quantitative data collection methods.

Type of studies

The experimental designs using randomised controlled trials, quasi-experimental and analytical studies were considered and summaries were used to identify the best evidence.

Search strategy

The search strategy assessed published studies written in English language after 2007. Initial search was done to reveal all relevant concepts relating to the aim of the review. Initial search included PubMed, Cumulative index to nursing and allied health literature (CINAHL) and MEDLINE shadowed by an analysis of the text words contained in the title, abstract and index terms. Keywords were nursing education, nurse, simulation, human patient simulation, manikin, technology, outcomes, teaching, learning, efficacy and high fidelity. This search recorded 472, 381 and 294 articles respectively, while duplications existed. The focus was advanced to HFS and learning outcomes in nursing, simulation and teaching, simulation and education and HFS and effectiveness. A second search of the electronic databases was used with some combinations and permutations of key

words and index terms recognised by the initial literature scoping. Defined search and retrieval methods were used in searching databases like PubMed, CINAHL, Cochrane, EMBASE, ERIC, MEDLINE, Ovid, Proquest, PsycINFO, Scopus, SciVal, Web of Science, Joanna Briggs Institute and EBSCO host. A total 368 articles were identified after excluding the duplication from the nursing literature.

A total of 45 articles had common consensus between the two reviewers with the aim of the review. Among the 45 articles, 18 articles were experimental, 15 were quasi-experimental, and 12 were analytical studies. The findings of each study were considered with codes for identification from the literature, summarization, synthesis and inferences, and discussion of findings for clarifying the interpretation themes.

Methods of the review

Assessment of methodological quality

Articles selected for retrieval were assessed for methodological validity by two independent reviewers prior to inclusion in the review. Critical appraisal assessment and review was done with agreement between the reviewers and a third reviewer was consulted when needed.

Data collection

Data was extracted from the literature included in the review using standardised data extraction using specific details about the interventions, populations, study methods and outcomes of significance to the aim of the review.

RESULTS OF ANALYSIS

Review articles show that simulation and debriefing is an interactive forum to transform knowledge to practice for safe and effective patient care in a non-risk learning and environment and impacts the quality of learning (Bradley, 2011). It is effective for improving performance and organization in intensive care (Nimmo, Shippey & Fluit, 2008). Engagement in simulation increases learning experience

and replaces time spent with patients in the clinical placement (Berragan, 2011). Registered nurses also play a vital role for final year students to facilitate teaching-learning (D'Souza, Jolly & 2013). HFS was useful in increasing clinical reasoning skills among nursing students (Lapkin, Fernandez, Levett-Jones & Bellchambers, 2010). Nursing student (n=151) responses had positive perceptions of simulation as useful to realizing learning objectives (Howard, Englert Kameg, & Perozzi, 2011).

Literature shows that simulation improves communication, accountability, awareness of nursing action, performing to the best ability, practice and repetition of skills, errors and omissions. It improves critical thinking, clinical judgment, skill acquisition, clinical reasoning, patient safety and interprofessionalism (Bussard, 2015). Nursing students (n=147) had significant core competencies and professional attitude in active learning compared to traditional learning group (Shin, Sok, Hyun & Kim, 2015). Nursing students (N=5) showed that simulation experience provides skill acquisition in a safe, controlled environment and is an integral part of nursing education (Henneman & Cunningham, 2005).

Use of remote communication devices, information sharing, skills and coping in emergencies showed significant differences in the haemorrhage and respiratory simulated scenarios. This helps to trigger cognitive processes for efficient orientation and awareness in situ-interventions (Chapelain, Morineau & Gautier, 2015). Advanced novice to competent intensive care registered nurses (n=53) showed significantly higher scores in assessments and team performance in the simulated emergency and cardiac arrest scenarios in different specialties in Ottawa (Ballangrud, Persenius, Hedelin & Hall-Lord, 2014). Adult health nursing students (n=143) reported high satisfaction and acute care knowledge and skills in simulated acute units and supportive learning environments (Nickless, 2011). Nursing students (N=16)

expressed satisfaction with simulation experiences (Lewis & Ravert, 2014).

Students had increased identification of safety measures in alcohol withdrawal scenario, assessments, identifying and prioritizing nursing interventions in simulated critical mental health scenarios of psychosocial concepts and debriefing reflection and inquiry. This promotes communication exchanges between student and simulated patient (Beckford, 2013). Mental health simulation scenarios improve theory to practice skills and experience through simulated real life and they are valued in learning among Australian nurses (Edward, Hercelinskyj, Warelow & Munro, 2007). Psychiatric mental health nursing students (n=20) believed that simulation activity was effective to practice assessment, critical thinking, decision-making, and nursing care in augmenting real-life clinical experiences. Consequently simulation scenarios were experiential, constructivist and reflective learning in increasing learning (Murray, 2014).

Nursing students (n=35) found a significant increase in team-based behaviours, cultural, practice, shared mental model, adaptive communication and response, cooperation with simulation (Garbee, Paige, Bonanno, Rusnak, Barrier, Kozmenko, & Nelson, 2013). There is a challenge of impact of learning outcomes on translation of skills to clinical management of various patients or interaction with various disciplines. BScN Chinese students (n=59) had high satisfaction and self-confidence, objectives and information with moderate-fidelity MicroSim compared to HFS SimMan (Wang, Fitzpatrick & Petrini, 2013). BSN medical surgical nursing students (n=94) had significant mean exam scores in simulation compared to didactic. HFS is innovative in gaining and knowledge retention (Strickland & March, 2015). Second year undergraduate nursing students (n=104) reported high knowledge and satisfaction with current learning, self-confidence in learning with independent roles to develop practice, communication

and collaboration skills in HFS (Thidemann & Soderhamn, 2013).

Nursing students (n=260) expressed higher knowledge and skill competence scores compared to the control group (Hana, Mohamed, Amany, Sheble & Shrief, 2014). Students (n=16) had improved knowledge, performances and self-confidence in simulation compared to other methods (Liaw, Scherpbier, Rethans & Klainin-Yobas, 2012). First year pre-licensure nursing students (n=168) had higher perceived competence (Oldenberg, Maney, & Plonczynski, 2013). American and Norwegian students (n=48) perceived increased practice, confidence and cultural awareness with simulated patients (Grossman, Mager, Opheim & Torbjornsen, 2012). American students (n=144) had significantly higher performance retention and self-confidence in simulated scenarios compared to other active learning strategies (Swanson, Nicholson, Boese, Cram, Stineman & Tew, 2011). Junior American nursing students (n=134) have had improved assessment skills, critical thinking and satisfaction to learn different nursing roles in the simulated scenarios (Guhde, 2011). Midwest American students (n=120) had higher therapeutic performance skills in paediatric simulation experiences compared to control group (Meyer, Connors, Hou, & Gajewski, 2011).

Senior nursing students (n=61) had significant differences in simulation compared to traditional learning (Rode, Callihan & Barnes, 2016). Nursing students (n=35) identified planning and prioritizing, understanding and implementing knowledge and communication and thoughtfulness, self-awareness (Lestander, Lehto & Engstrom, 2016). Students (n=60) reported better improvements in clinical judgement and performance in real acute situations using HFS compared to traditional learning (Hallin, Backstrom, Haggstrom & Kristiansen, 2016). Nursing students (n=72) had significant improvement in self-confidence, critical thinking skills and problem solving tasks and objectives in

simulation scenarios (Ahn & Kim, 2015). Nursing students (n=107) perceived HFS as promoting critical thinking, confidence, competence, theory-practice integration and knowledge identification (Kaddoura, Vandyke, Smallwood & Gonzalez, 2016). Nursing students (n=42) have higher mean clinical judgement scores and improved over time in the intervention group compared to the control group. They expressed structured debriefing as learner focused and holistic (Mariani, Cantrell, Meakim, Prieto, & Dreifuerst, 2013).

Interdisciplinary health care communication performance, SBAR, physician reporting blood pressure and oxygen saturation and client identification were higher among senior nursing cohorts exposed to repeated simulation learning. It helps to organize information, care, complete reporting and decision-making (Krautscheid, 2008). Inter-professional collaboration simulation scenarios benefit students to think critically, and apply theoretical knowledge to manage emergencies and varied patient conditions to ensure safe patient care (Ying et al., 2011). Nursing students (n=15) had positive feedback about participation in interprofessional teamwork and cohesive team in delivering care to the dying patient and their families in a simulated palliative care environment. They felt the need for patient and family-centred care and focus on patient and family needs (Gillan, Arora, Sanderson & Turner, 2013). Nursing students (N=41) had significant improvements in knowledge retention and translation to patient care with simulation compared to didactic lectures and MCQs in critical care (Solymos, O'Kelly & Walshe, 2015).

Pre-briefing on expectation in the simulation environment and debriefing model as a guided reflection improves in complex interventions and simulated patient deterioration scenarios. It improved perceptions of deterioration and development of appropriate responses in practice (Lavoie, Pepin & Cossetee, 2015).

These studies show that HFS is an effective teaching-learning tool to improve clinical competence, critical thinking, self-confidence, and integration of knowledge in safe, controlled environment. It reinforces knowledge in a safe patient care environment and enhances newly learned skills.

DISCUSSION

In this integrative review, common themes emerged were learning in a safe, supportive and simulated environment, self-satisfaction and confidence, critical thinking and clinical reasoning, clinical decision-making and clinical judgement, knowledge retention and knowledge gain, skill acquisition and performance, interprofessional collaborative nursing and nursing care, teamwork and communication, development of cognitive, psychomotor and behavioural skills in nursing.

Review studies revealed that BScN students and Registered nurses, at various levels, ages and disciplines had higher satisfaction, self-confidence to face real clinical situations in a safe controlled environment. Higher satisfaction and self-confidence were observed in anticipating scenarios related to assessment, readiness to intervene appropriately and interpreting the situation comprehensively. Satisfaction and self-confidence are internal outcomes of simulation experience (Norman, Dore, & Grierson, 2012) and have presented improvements in critical cue recognition and problem identification (Rodriguez, 2015). Moderate-fidelity simulation received significantly higher scores in students' satisfaction and self-confidence, while the high-fidelity simulation showed better implementation of the simulation design (Wang et al., 2013). Higher age, higher GPA, completion of clinical courses and senior cohorts was associated with the Student engagement mean scores (D'Souza, Isaac, et al., 2014).

Pre-briefing, simulation and debriefing was beneficial in sequencing of the learning experiences, especially in the

“feedback/guided reflection” improves critical thinking, persistence of reflective thinking for patient care (Mariani, Cantrell, Meakim, Prieto, & Dreifuerst, 2013) and active learning (Sinclair & Ferguson, 2009). This encourages engagement in learning major concepts and collaborative practice (Titzer, Swenty, & Hoehn, 2012) and ‘learning as a concept’ (Tosterud, Hedelin, & Hall-Lord, 2013). Structured objectives, feedback and high expectations during simulation experiences prompt student nurses to expand their competency levels. Feedback on performance and satisfaction was effectively used in the premises of learning for preparing nursing students (D’Souza et al., 2015). These studies spectacle that simulation learning experiences increases student’s hands-on experience and links theory and nursing practice through hands-on experience and guided reflection.

Students learn to make sound decision-making and critical thinking (Goodstone et al., 2013; Loke et al., 2014) and advanced skills (Mills et al., 2014). It improves clinical judgement (Bultas et al., 2014; Hao et al., 2014) and nurture affective and cognitive learning (Kaddoura, 2012; Kaddoura & Williams, 2012; Lowenstein, 2014). HFS is an effective tool to improve competence (Bultas et al., 2014; Lucas, 2014; Mould et al., 2011) learning in nursing (Tawalbeh & Tubaishat, 2014). Students have increased satisfaction (Sharp et al., 2014), knowledge retention (Tawalbeh & Tubaishat, 2014) and self-efficacy and self-confidence (Cardoza & Hood, 2012; Lucas, 2014). Age and GPA have significant satisfaction with the learning environment among Omani nursing students (D’Souza et al., 2015). Students manifested higher self-confidence, critical thinking and problem solving abilities in the simulation scenarios. This can develop their psychomotor competencies with simulated technology to manage nursing problems, emergencies and collaboration for safe patient care.

Students reported engagement in learning (Gates et al., 2012; Liaw et al., 2012; Yuan et al., 2012), ‘theory-practice integration’ and application of skills. It improves transfer of learning into nursing practice (Gates et al., 2012; Liaw et al., 2012; Yuan et al., 2012) with no-risks in the safe environment (Oermann & Gaberson, 2014). Active learning improves competency (Shin et al., 2014) engaged in learning opportunities. These quantitative evidences highlight that HPS is an effective teaching method for undergraduate nurse education (Strickland et al., 2015). Therefore, simulation provides visualization of unexpected emergencies in a safe environment to develop assessment and management practice. Hence, HPS supports students’ self-satisfaction, confidence, and knowledge retention and skill acquisition with debriefing. HPS provides real clinical experiences for teaching concepts and application of nursing using patient scenarios of varying acuity.

Literature search can be directed towards qualitative approach to gain a comprehensive insight into psychosocial and behavioural outcomes and translation into clinical practice.

CONCLUSION AND IMPLICATION

Nurse educators can create and develop a variety of patient conditions in various specialities to learn to manage nursing care and collaborated with health care. Use of HFS for improving learning outcome in nursing education is an effective and innovative tool. Satisfaction with and effectiveness of the learning environments are influenced by cognitive, psychomotor and affective skills, and problem-solving abilities. The use of high-fidelity clinical simulation into the undergraduate nursing education can improve the quality of learning, can help students for team work, problem-solving, organize care and promote clinical decision-making. This can improve knowledge, performance and attitude among nurses for application and translation to bedside practice. Debriefing and pre-

briefing provide interactive sessions to apply knowledge and exchange critical elements and key points in nursing care. Integration of HFS in nursing education can reinforce the standards of nursing practice and student learning outcomes for safe nursing practice. Simulation is useful in BSN and RN programs with specialised training in a safe environment at the rate and direction of the student for self-discovery, self-directed and independent learning.

Authorship

MSD, PA and RV provide substantial contributions to the conception, acquisition of review, drafting the article, revising it critically for important intellectual content and agreed on the final version of the paper to be published. Melba Sheila D'Souza (MSD), PorkodiArjunan (PA) and Ramesh Venkatesaperumal (RV).

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REFERENCES

- Aebersold, M. & Tschannen, D., 2013. Simulation in nursing practice: the impact on patient care. *OJIN: The Online Journal of Issues*. Available at: <http://www.nursingworld.org/MainMenuCategories/ANAMarketplace/ANAPeriodicals/OJIN/TableofContents/Vol-18-2013/No2-May-2013/Simulation-in-Nursing-Practice.html> [Accessed July 22, 2016].
- Ahn, H. & Kim, H.Y., 2015. Implementation and outcome evaluation of high-fidelity simulation scenarios to integrate cognitive and psychomotor skills for Korean nursing students. *Nurse Education Today*, 35(5), pp.706–711. Available at: <http://dx.doi.org/10.1016/j.nedt.2015.01.021>.
- Alexander, M. et al., 2015. NCSBN Simulation Guidelines for Prelicensure Nursing Programs. *Journal of Nursing Regulation*, 6(3), pp.39–42. Available at: <http://linkinghub.elsevier.com/retrieve/pii/S2155825615307833> [Accessed July 22, 2016].
- Anon, 2013. World Medical association declaration of Helsinki. *JAMA*, 310(20), p.2194.
- Ballangrud, R. et al., 2014. Exploring intensive care nurses' team performance in a simulation-based emergency situation, – expert raters' assessments versus self-assessments: an explorative study. *BMC Nursing*, 13(1), p.47. Available at: <http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=4299298&tool=pmcentrez&rendertype=abstract>.
- Barbosa, S. & Marin, H., 2009. Web-based simulation: a tool for teaching critical care nursing. *Revista latino-americana de enfermagem*. Available at: http://www.scielo.br/scielo.php?pid=S0104-11692009000100002&script=sci_arttext&tlng=es [Accessed July 22, 2016].
- Beckford, D.M.H.M., 2013. Utilizing simulation curriculum to decentralize mental health concepts. , 2013(June), pp.227–229.
- Berragan, L., 2011. Simulation: an effective pedagogical approach for nursing? *Nurse Education Today*. Available at: <http://www.sciencedirect.com/science/article/pii/S0260691711000384> [Accessed July 22, 2016].
- Bogossian, F. et al., 2014. Undergraduate nursing students' performance in recognising and responding to sudden patient deterioration in high psychological fidelity simulated environments: An. *Nurse Education*. Available at: <http://www.sciencedirect.com/science/article/pii/S0260691713003602> [Accessed July 22, 2016].
- Bradley, C., 2011. The role of high-fidelity clinical simulation in teaching and learning in the health professions. , pp.33–42.
- Brady, D., 2011. Using Quality and Safety Education for Nurses (QSEN) as a pedagogical structure for course redesign and content. *International Journal of Nursing Education Scholarship*. Available at:

- <http://www.degruyter.com/view/j/ijnes.2011.8.issue-1/ijnes.2011.8.1.2147/ijnes.2011.8.1.2147.xml> [Accessed July 22, 2016].
- Bultas, M. et al., 2014. Effectiveness of high-fidelity simulation for pediatric staff nurse education. *Pediatric nursing*. Available at: <http://search.proquest.com/openview/a1f74b4696b0a03ffd6d938d4f156b55/1?pq-origsite=gscholar> [Accessed July 22, 2016].
 - Bussard, M.E., 2015. High-Fidelity Simulation to Teach Accountability to Prelicensure Nursing Students. *Clinical Simulation in Nursing*, 11(9), pp.425–430. Available at: <http://dx.doi.org/10.1016/j.ecns.2015.05.009>.
 - Cardoza, M. & Hood, P., 2012. Comparative study of baccalaureate nursing student self-efficacy before and after simulation. *CIN: Computers, Informatics, Nursing*. Available at: http://journals.lww.com/cinjournal/Abstract/2012/03000/Comparative_Study_of_Baccalaureate_Nursing_Student.5.aspx [Accessed July 22, 2016].
 - Cato, M., 2012. using simulation in nursing education,
 - Chapelain, P., Morineau, T. & Gautier, C., 2015. Effects of communication on the performance of nursing students during the simulation of an emergency situation. *Journal of Advanced Nursing*, 71(11), pp.2650–2660.
 - Chism, L., 2010. the doctor of nursing practice,
 - D'Souza MS, Jose, J., and Al-Jabri, S., 2013. perceptions of teaching undergraduate student. *Journal of scientific research*, 111(3), pp.289–299.
 - d'Souza, M., Karkada, S. & Parahoo, K., 2015. Perception of and satisfaction with the clinical learning environment among nursing students. *Nurse education*. Available at: <http://www.sciencedirect.com/science/article/pii/S026069171500074X> [Accessed July 22, 2016].
 - D'Souza, M.S., Venkatesaperumal, R., et al., 2013. Engagement in clinical learning environment among nursing students: Role of nurse educators. *Open Journal of Nursing*, 03(01), pp.25–32. Available at: <http://www.scirp.org/journal/PaperInformation.aspx?PaperID=28714>.
 - D'Souza, M.S., Isac, C., et al., 2013. Exploring nursing student engagement in the learning environment for improved learning outcomes. *Clinical Nursing Studies*, 2(1). Available at: <http://www.sciedupress.com/journal/index.php/cns/article/view/2894> [Accessed July 22, 2016].
 - D'Souza, M.S., Karkada, S.N. & Castro, R., 2014. Exploring e-learning among nurse educators in undergraduate nursing. *Journal of Nursing Education and Practice*, 4(7), pp.73–84. Available at: <http://www.sciedu.ca/journal/index.php/jnep/article/view/3955>.
 - DeBourgh, G. & Prion, S., 2011. Using simulation to teach prelicensure nursing students to minimize patient risk and harm. *Clinical Simulation in Nursing*. Available at: <http://www.sciencedirect.com/science/article/pii/S1876139909005799> [Accessed July 22, 2016].
 - Dowie, I. & Phillips, C., 2011. Supporting the lecturer to deliver high-fidelity simulation. *Nursing standard*. Available at: <http://journals.rcni.com/doi/abs/10.7748/ns2011.08.25.49.35.c8651> [Accessed July 22, 2016].
 - Duphily, N., 2014. Simulation education: A primer for professionalism. *Teaching and Learning in Nursing*. Available at: <http://www.sciencedirect.com/science/article/pii/S1557308714000304> [Accessed July 22, 2016].
 - Edward, K. et al., 2007. Simulation to Practice: Developing Nursing Skills in Mental Health--An Australian Perspective. *International Electronic Journal of Health Education*, 10, pp.60–64. Available at: <http://search.ebscohost.com/login.aspx?direct=true&db=eric&AN=EJ794196&login.asp&site=ehost-live>
<http://www.aahperd.org/iejhe/template.cfm?template=currentIssue.cfm#volume10>.
 - Edward, K. et al., 2007. Simulation to Practice: Developing Nursing Skills in Mental Health--An Australian Perspective. *International electronic journal*. Available at: <http://eric.ed.gov/?id=EJ794196> [Accessed July 22, 2016].

- Fatima, S. De et al., 2009. Web-based simulation: a tool for teaching critical care nursing. , 17(1), pp.7–13.
- Fisher, D. & King, L., 2013. An integrative literature review on preparing nursing students through simulation to recognize and respond to the deteriorating patient. *Journal of Advanced Nursing*, 69(11), pp.2375–2388.
- Garbee, D.D. et al., 2013. Effectiveness of teamwork and communication education using an interprofessional high-fidelity human patient simulation critical care code., 3(3), pp.1–12.
- Garrett, B.M., MacPhee, M. & Jackson, C., 2011. Implementing high-fidelity simulation in Canada: Reflections on 3years of practice. *Nurse Education Today*, 31(7), pp.671–676.
- Gates, M., Parr, M. & Hughen, J., 2012. Enhancing nursing knowledge using high-fidelity simulation. *Journal of Nursing Education*. Available at: <http://www.healio.com/nursing/journals/jne/enhancing-nursing-knowledge-using-high-fidelity-simulation> [Accessed July 22, 2016].
- Gillan, P.C. et al., 2013. Palliative Care Simulation: Nurturing Interprofessional Collegiality. *Health and Interprofessional Practice*, 2(1), p.eP1051. Available at: <http://commons.pacificu.edu/hip/vol2/iss1/4/>.
- Goodstone, L., Goodstone, M. & Cino, K., 2013. Effect of simulation on the development of critical thinking in associate degree nursing students. *Nursing education*. Available at: http://journals.lww.com/neponline/Abstract/2013/05000/Effect_of_Simulation_on_the_Development_of.5.aspx [Accessed July 22, 2016].
- Grossman, S., Mager, D. & Opheim, H., 2012. A bi-national simulation study to improve cultural awareness in nursing students. *Clinical Simulation in*. Available at: <http://www.sciencedirect.com/science/article/pii/S1876139911000065> [Accessed July 22, 2016].
- Guhde, J., 2011. Nursing Students' Perceptions of the Effect on Critical Thinking, Assessment, and Learner Satisfaction in Simple Versus Complex High-Fidelity Simulation Scenarios. *Journal of Nursing Education*, 50(2), pp.73–78. Available at: <http://www.slackinc.com/doi/resolver.aspx?doi=10.3928/01484834-20101130-03> [Accessed July 22, 2016].
- Hallin, K. et al., 2016. High-fidelity patient simulation: Assessment of student nurses' team achievements of clinical judgement. *Nurse Education in Practice*, 19, pp.12–18. Available at: <http://www.scopus.com/inward/record.url?eid=2-s2.0-84962868639&partnerID=tZOtx3y1>.
- Hanan. M. Soliman., Amani. M. shelba., W. shari., 2014. Effectiveness of simulation training on clinical nursing education. *The international journal of advanced research*, 2(4), pp.387–393.
- Handwerker, S., 2012. Transforming nursing education: a review of current curricular practices in relation to Benner's latest work. *International journal of nursing education*. Available at: <http://www.degruyter.com/dg/viewarticle.fullcontentlink:pdfeventlink> [Accessed July 22, 2016].
- Harder, B.N., 2010. Use of simulation in teaching and learning in health sciences: a systematic review. *The Journal of nursing education*, 49(1), pp.23–28.
- Hayden, J., Jeffries, P. & Kardong-Edgren, S., 2012. The NCSBN national simulation study. *Clinical Simulation in Nursing*. Available at: [http://www.anselm.edu/Documents/Academics/Departments/Nursing/Continuing Education/SESSION H JEFFRIES Simulation Study-MA-NLN\(0\).pdf](http://www.anselm.edu/Documents/Academics/Departments/Nursing/Continuing%20Education/SESSION%20H%20JEFFRIES%20Simulation%20Study-MA-NLN(0).pdf) [Accessed July 22, 2016].
- Henneman, E. a & Cunningham, H., 2005. Using clinical simulation to teach patient safety in an acute/critical care nursing course. *Nurse educator*, 30(4), pp.172–177.
- Howard, V., Ross, C. & Mitchell, A., 2010. Human patient simulators and interactive case studies: A comparative analysis of learning outcomes and student perceptions. *CIN: Computers*,. Available at: http://journals.lww.com/cinjournal/Abstract/2010/01000/Human_Patient_Simulators_and_Interactive_Case.10.aspx [Accessed July 22, 2016].

- Jeffries PR, 2012. Simulation in nursing education: from conceptualization to evaluation, National league for Nursing .
- Kaddorura, M. & Williams, C., 2012. Comparison of Generic Accelerated Nursing Students. Educational Research Quarterly. Available at: <http://eric.ed.gov/?id=EJ1061972> [Accessed July 22, 2016].
- Kaddoura, M., 2010. New graduate nurses' perceptions of the effects of clinical simulation on their critical thinking, learning, and confidence. The Journal of Continuing Education in Nursing. Available at: <http://www.healio.com/nursing/journals/jce n/2010-11-41-11/%7Bbe750854-40f0-42a9-bd60-22f117b5442f%7D/new-graduate-nurses-perceptions-of-the-effects-of-clinical-simulation-on-their-critical-thinking-learning-and-confidence> [Accessed July 22, 2016].
- Kaddoura, M. et al., 2015. Perceived benefits and challenges of repeated exposure to high fidelity simulation experiences of first degree accelerated bachelor nursing students. Nurse education today, 36, pp.298–303. Available at: <http://www.sciencedirect.com/science/article/pii/S0260691715002841>.
- Krautscheid, L.C., 2008. Improving communication among healthcare providers: preparing student nurses for practice. International journal of nursing education scholarship, 5(1), p.Article40. Available at: <http://www.ncbi.nlm.nih.gov/pubmed/18976237>.
- Lapkin, S. et al., 2010. Effectiveness of Patient Simulation Manikins in Teaching Clinical Reasoning Skills to Undergraduate Nursing Students: A Systematic Review. Clinical Simulation in Nursing, 6(6), pp.e207–e222.
- Lavoie, P., Pepin, J. & Cossette, S., 2015. Development of a post-simulation debriefing intervention to prepare nurses and nursing students to care for deteriorating patients. Nurse Education in Practice, 15(3), pp.181–191. Available at: <http://dx.doi.org/10.1016/j.nepr.2015.01.006>.
- Lestander, Ö., Lehto, N. & Engström, Å., 2016. Nursing students' perceptions of learning after high fidelity simulation: Effects of a Three-step Post-simulation Reflection Model. Nurse Education Today, 40, pp.219–224. Available at: <http://dx.doi.org/10.1016/j.nedt.2016.03.011>.
- Lewis, R., Strachan, A. & Smith, M., 2012. Is high fidelity simulation the most effective method for the development of non-technical skills in nursing? A review of the current evidence. The Open Nursing Journal. Available at: <http://benthamopen.com/FULLTEXT/TONURSJ-6-82> [Accessed July 22, 2016].
- Liaw, M. & Ying, S., 2007. The Integration of Simulation into Undergraduate Nursing Curriculum Deepening Students' Learning Facilitating the Transition from Classroom to Clinical Practice. , pp.2002–2005.
- Liaw, S. et al., 2011. Rescuing A Patient In Deteriorating Situations {RAPIDS}: A simulation-based program on recognizing, responding and reporting of physiological signs of. Available at: <http://scholarbank.nus.edu.sg/handle/10635/121286> [Accessed July 22, 2016].
- Liaw, S., Scherpbier, A. & Rethans, J., 2012. Assessment for simulation learning outcomes: a comparison of knowledge and self-reported confidence with observed clinical performance. Nurse Education. Available at: <http://www.sciencedirect.com/science/article/pii/S0260691711002681> [Accessed July 22, 2016].
- Loke, J. et al., 2014. High fidelity full sized human patient simulation manikins: Effects on decision making skills of nursing students. Journal of Nursing Education. Available at: <http://sciedupress.com/journal/index.php/jnep/article/view/4250> [Accessed July 22, 2016].
- Lucas, A., 2014. Promoting continuing competence and confidence in nurses through high-fidelity simulation-based learning. The Journal of Continuing Education in Nursing. Available at: <http://www.healio.com/nursing/journals/jce n/2014-8-45-8/%7B4b02b39d-f952-412b-9dcd-65f40ff9d150%7D/promoting-continuing-competence-and-confidence-in-nurses-through-high-fidelity-simulation-based-learning> [Accessed July 22, 2016].

- Mariani, B. et al., 2013. Structured Debriefing and Students' Clinical Judgment Abilities in Simulation. *Clinical Simulation in Nursing*, 9(5), pp.e147–e155. Available at: <http://dx.doi.org/10.1016/j.ecns.2011.11.009>.
- McGaghie, W.C. et al., 2010. A critical review of simulation-based medical education research: 2003-2009. *Medical Education*, 44(1), pp.50–63.
- McKenzie, R. et al., 2015. Safety on the line – a short report on the Open Access development of a quality improvement model for a nurse and GP helpline using simulated patients. , 23, pp.163–166.
- Meakim, C., Boese, T. & Decker, S., 2013. Standards of best practice: Simulation standard I: Terminology. *Clinical Simulation*. Available at: [http://www.nursingsimulation.org/article/S1876-1399\(13\)00071-6/fulltext?mobileUi=0](http://www.nursingsimulation.org/article/S1876-1399(13)00071-6/fulltext?mobileUi=0) [Accessed July 22, 2016].
- Meyer, M., Connors, H. & Hou, Q., 2011. The effect of simulation on clinical performance: A junior nursing student clinical comparison study. *Simulation in Health Care*. Available at: http://journals.lww.com/simulationinhealthcare/Abstract/2011/10000/The_Effect_of_Simulation_on_Clinical_Performance_3.aspx [Accessed July 22, 2016].
- Mills, J. et al., 2014. “Putting it together”: Unfolding case studies and high-fidelity simulation in the first-year of an undergraduate nursing curriculum. *Nurse Education in Practice*. Available at: <http://www.sciencedirect.com/science/article/pii/S1471595313001224> [Accessed July 22, 2016].
- Mould, J., White, H. & Gallagher, R., 2011. Evaluation of a critical care simulation series for undergraduate nursing students. *Contemporary Nurse*. Available at: <http://www.tandfonline.com/doi/abs/10.5172/conu.2011.38.1-2.180> [Accessed July 22, 2016].
- Murray, B., 2014. The use of high-fidelity simulation in psychiatric and mental health nursing clinical education. *International Journal of Health Sciences Education*, 2(1).
- Nickless, L.J., 2011. The use of simulation to address the acute care skills deficit in pre-registration nursing students: A clinical skill perspective. *Nurse Education in Practice*, 11(3), pp.199–205. Available at: <http://dx.doi.org/10.1016/j.nepr.2010.09.001>
- Nimmo, G.R., 2008. Intensive care and simulation — a guide. *Care of the Critically Ill*, 24(1), pp.4–8.
- Norman, G., Dore, K. & Grierson, L., 2012. The minimal relationship between simulation fidelity and transfer of learning. *Medical Education*, 46(7), pp.636–647.
- Oermann, M. & Gaberson, K., 2013. Evaluation and testing in nursing education, Available at: https://books.google.com/books?hl=en&lr=&id=ahdoia_JYJQC&oi=fnd&pg=PP2&dq=Oermann,+M.H.,+Gaberson,+K.B.,+2014.+Evaluation+and+Testing+in+Nursing+Education.+Springer+Publishing,+NY,+NY&ots=4a_f_RhYwB&sig=pE0Xuz_tum_bxvtJowrQTr8Ai8g [Accessed July 22, 2016].
- Oh, S.H. et al., 2014. Automatic delirium prediction system in a Korean surgical intensive care unit. *Nursing in Critical Care*, 19(6), pp.281–291.
- Oldenburg, N. et al., 2012. Student-created scenarios in the high-fidelity simulation laboratory. *Journal of Nursing Education*. Available at: <http://www.healio.com/nursing/journals/jne/2012-12-51-12/%7B569d29d0-044b-4f7e-a03e-369b7d88be44%7D/student-created-scenarios-in-the-high-fidelity-simulation-laboratory> [Accessed July 22, 2016].
- Oldenburg, N., Maney, C. & Plonczynski, D., 2013. Traditional clinical versus simulation in 1st semester clinical students: students perceptions after a 2nd semester clinical rotation. *Clinical Simulation in Nursing*. Available at: <http://www.sciencedirect.com/science/article/pii/S1876139912000503> [Accessed July 22, 2016].
- Partin, J., Payne, T. & Slemmons, M., 2011. Students' Perceptions of Their Learning Experiences Using High-Fidelity Simulation to Teach Concepts Relative to Obstetrics. *Nursing Education*. Available at: http://journals.lww.com/neponline/Abstract/2011/05000/Students__Perceptions_of_Their_Learning.11.aspx [Accessed July 22, 2016].
- Powell-Laney, S.K., 2011. The use of human patient simulators to enhance the clinical decision making of nursing students.

- Dissertation Abstracts International Section A: Humanities and Social Sciences, 71(10-A), p.3544. Available at: <http://search.ebscohost.com/login.aspx?direct=true&AuthType=cookie,ip&db=psyh&AN=2011-99070-067&site=ehost-live>.
- Raman, S. & Noronha, J.M.J.M.G.R.S.V.A.A., 2011. Undergraduate Arab Nursing Students Simulation Training (SST) Using Maternity Simulaids: An overview of obstetric skill performance assessment by OSCE, Skill Competency and Student Satisfaction. Undergraduate Arab Nursing Students Simulation Training (SST) Using Maternity Simulaids: An overview of obstetric skill performance assessment by OSCE, Skill Competency and Student Satisfaction., 3(2). Available at: <http://search.ebscohost.com/login.aspx?direct=true&site=ehost-live&db=ccm&AN=104619783> [Accessed July 22, 2016].
 - Ravert, P., 2008. Patient simulator sessions and critical thinking. Journal of Nursing Education. Available at: <http://www.healio.com/nursing/journals/jne/2008-12-47-12/%7B1540de98-db67-4e7b-9021-570a87248df7%7D/patient-simulator-sessions-and-critical-thinking> [Accessed July 22, 2016].
 - Reese, C.E., Jeffries, P.R. & Engum, S. a, 2010. Using Simulations to Develop Nursing and Medical Student Collaboration. Nursing education perspectives, 31(1), pp.33–8.
 - Ricketts, B., 2011. The role of simulation for learning within pre-registration nursing education -- A literature review. Nurse Education Today, Vol. 31 (7), p.650,5.
 - Rode, J.L., Callihan, M.L. & Barnes, B.L., 2016. Assessing the Value of Large-Group Simulation in the Classroom. Clinical Simulation in Nursing, 12(7), pp.251–259. Available at: <http://dx.doi.org/10.1016/j.ecns.2016.02.012>.
 - Rodriguez, L., 2015. A Mixed Method Study of the Impact and Outcomes of Graduates of the CSU Northern California Consortium Doctor of Nursing Practice Program Class of 2014. Available at: http://scholarworks.sjsu.edu/nursing_pub/11/ [Accessed July 22, 2016].
 - Rutherford-Hemming, T. et al., 2016. After the National Council of State Boards of Nursing Simulation Study-Recommendations and Next Steps. Clinical Simulation in Nursing, 12(1), pp.2–7. Available at: <http://dx.doi.org/10.1016/j.ecns.2015.10.010>.
 - Sharp, P., Newberry, L. & Fleishauer, M., 2014. High-fidelity simulation and its nursing impact in the acute care setting. Nursing. Available at: http://journals.lww.com/nursingmanagement/Fulltext/2014/07000/High_fidelity_simulation_and_its_nursing_impact_in.9.aspx [Accessed July 22, 2016].
 - Shearer, J., 2012. High-fidelity simulation and safety: an integrative review. Journal of Nursing Education. Available at: <http://www.healio.com/nursing/journals/jne/2013-1-52-1/%7B64d05998-8a07-43a2-980c-d768a96236ab%7D/high-fidelity-simulation-and-safety-an-integrative-review?version=1> [Accessed July 22, 2016].
 - Shin, H. et al., 2015. Competency and an active learning program in undergraduate nursing education. Journal of Advanced Nursing, 71(3), pp.591–598.
 - Shin, I. & Kim, J., 2013. The effect of problem-based learning in nursing education: a meta-analysis. Advances in Health Sciences Education. Available at: <http://link.springer.com/article/10.1007/s10459-012-9436-2> [Accessed July 22, 2016].
 - Sideras, S., McKenzie, G. & Noone, J., 2013. Making simulation come alive: Standardized patients in undergraduate nursing education. Nursing Education. Available at: http://journals.lww.com/neponline/Fulltext/2013/11000/Making_Simulation_Come_Alive__Standardized.13.aspx [Accessed July 22, 2016].
 - Sinclair, B. & Ferguson, K., 2009. Integrating Simulated Teaching/Learning Strategies in Undergraduate Nursing Education. International Journal of Nursing Education Scholarship, 6(1). Available at: <http://www.degruyter.com/view/j/ijnes.2009.6.1/ijnes.2009.6.1.1676/ijnes.2009.6.1.1676.xml> [Accessed July 22, 2016].
 - Solymos, O., O'Kelly, P. & Walshe, C.M., 2015. Pilot study comparing simulation-based and didactic lecture-based critical

- care teaching for final-year medical students. *BMC anesthesiology*, 15(1), p.153. Available at: <http://www.scopus.com/inward/record.url?eid=2-s2.0-84945186319&partnerID=tZOtx3y1>.
- Sperling, J., Clark, S. & Kang, Y., 2013. Teaching medical students a clinical approach to altered mental status: simulation enhances traditional curriculum. *Medical education online*. Available at: <http://med-ed-online.net/index.php/meo/article/view/19775> [Accessed July 22, 2016].
 - Strickland, H.P. & March, A.L., 2015. Longitudinal Impact of a Targeted Simulation Experience on High-Stakes Examination Outcomes. *Clinical Simulation in Nursing*, 11(7), pp.341–347. Available at: <http://dx.doi.org/10.1016/j.ecns.2015.04.006>.
 - Swanson, EA, Nicholson AZ, Boose, tA., cram, E., Stineman AM, T.K., 2011. comparison of selected teaching strategies. *clinical simulation in Nursing*, 7(3), pp.e81–90.
 - Swenty, C. & Eggleston, B., 2011. The evaluation of simulation in a baccalaureate nursing program. *Clinical Simulation in Nursing*. Available at: <http://www.sciencedirect.com/science/article/pii/S1876139910000289> [Accessed July 22, 2016].
 - Tawalbeh, L. & Tubaishat, A., 2013. Effect of simulation on knowledge of advanced cardiac life support, knowledge retention, and confidence of nursing students in Jordan. *Journal of nursing education*. Available at: <http://www.healio.com/nursing/journals/jne/2014-1-53-1/%7B6b1d3c21-4cbb-4f9a-b1f6-675cb6252794%7D/effect-of-simulation-on-knowledge-of-advanced-cardiac-life-support-knowledge-retention-and-confidence-of-nursing-students-in-jordan> [Accessed July 22, 2016].
 - Thidemann, I.J. & S?derhamn, O., 2013. High-fidelity simulation among bachelor students in simulation groups and use of different roles. *Nurse Education Today*, 33, pp.1599–1604.
 - Thomas, C., McIntosh, C. & Allen, R., 2014. Creating a distraction simulation for safe medication administration. *Clinical Simulation in Nursing*. Available at: <http://www.sciencedirect.com/science/article/pii/S1876139914000644> [Accessed July 22, 2016].
 - Titzer, J., Swenty, C. & Hoehn, W., 2012. An interprofessional simulation promoting collaboration and problem solving among nursing and allied health professional students. *Clinical Simulation in Nursing*. Available at: <http://www.sciencedirect.com/science/article/pii/S1876139911000028> [Accessed July 22, 2016].
 - Tosterud, R., Hedelin, B. & Hall-Lord, M., 2013. Nursing students' perceptions of high- and low-fidelity simulation used as learning methods. *Nurse education in practice*. Available at: <http://www.sciencedirect.com/science/article/pii/S1471595313000279> [Accessed July 22, 2016].
 - Valler-Jones, T. & Meechan, R., 2011. Simulated practice--a panacea for health education? *Journal of Nursing*. Available at: <http://search.ebscohost.com/login.aspx?> [Accessed July 22, 2016].
 - Wang, A.L., Fitzpatrick, J.J. & Petrini, M.A., 2013. Comparison of two simulation methods on chinese bsn students' learning. *Clinical Simulation in Nursing*, 9(6), pp.e207–e212. Available at: <http://dx.doi.org/10.1016/j.ecns.2012.01.007>.
 - Weaver, A., 2011. High-Fidelity Patient Simulation in Nursing Education: An Integrative Review. *Nursing Education Perspectives*. Available at: http://journals.lww.com/neonline/Abstract/2011/01000/High_Fidelity_Patient_Simulation_in_Nursing.12.aspx [Accessed July 22, 2016].
 - Whyte, J. et al., 2012. Nurses' immediate response to the fall of a hospitalized patient: A comparison of actions and cognitions of experienced and novice nurses. *International journal of*. Available at: <http://www.sciencedirect.com/science/article/pii/S0020748912001137> [Accessed July 22, 2016].
 - Wilford, A. & Doyle, T., 2006. Integrating simulation training into the nursing curriculum. *British Journal of Nursing*. Available at: <http://caehealthcare.com/images/uploads/do>

- cuments/104/integratingsimulationtraining.pdf [Accessed July 22, 2016].
- Wotton, K., Davis, J., Button, D., & Kelton, M., 2010. Third-year undergraduate nursing students. *Journal of Nursing Education*, 49, pp.632–639.
 - Yuan, H., Williams, B. & Man, C., 2014. Nursing students' clinical judgment in high-fidelity simulation based learning: a quasi-experimental study. *Journal of Nursing Education*. Available at: <http://search.proquest.com/openview/f81f12b8f36913291d3694b8449e1bfb/1?pq-origsite=gscholar> [Accessed July 22, 2016].

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