Simulation-based education for neonatal skills training and its impact on self-efficacy in post-registration nurses

Simulation is a training methodology that is increasingly applied to healthcare education, with reported benefits to the practitioner, the team, the patient and the health service. Self-efficacy, or the belief in one's ability to succeed, is a commonly cited outcome of simulation training and can influence confidence, achievement and performance. This literature review explores whether a simulation-based approach to neonatal skills training impacts self-efficacy in post-registration nurses.

Clare Morfoot
RN, DipN, BSc(Hons), PGCE, MSc
Neonatal Practice Educator, Trevor Mann Baby Unit (NICU), Royal Sussex County Hospital, Brighton
clare.morfoot@bsuh.nhs.uk

Helen Stanley
RN, RNT, MSc, PGCE, Senior Fellow HEA
Academic Lead for Nursing, School of Health Sciences, University of Brighton

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Key points

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1. Increased self-efficacy could influence ability to perform a skill.
2. Studies within this review reveal a positive correlation between neonatal simulation experiences and improved confidence and self-efficacy among qualified nurses.
3. There is a paucity of robust quantitative data relating to the impact of neonatal simulation for post-registration nurses.
4. Further research is required to fully evaluate the impact of neonatal simulation on clinical performance, team behaviours, service delivery and patient outcome.

Simulation and self-efficacy

Simulation is defined as: "A technique, not a technology, to replace or amplify real experiences with guided experiences that evoke or replicate substantial aspects of the real world in a fully interactive manner."[1] It has been said that simulation is highly immersive and experiential, allowing reflection and critical thinking in a safe, secure and supportive environment.[1-4] Simulation is a strategy that is thought to enhance knowledge, procedural competence, communication, critical thinking, decision-making, confidence, self-efficacy, teamworking and an awareness of human factors.[3,5]

Self-efficacy is a term coined by Bandura[6] and is defined as: "Belief that one possesses the requisite skills to do what is needed to reach a successful outcome."[7] This concept underpins social cognitive theory and explores the relationship between external factors, motivation and performance. Self-efficacy can augment human accomplishment and confidence by influencing feelings of optimism, perseverance and the ability to take on new tasks, which could then have implications for the delivery of quality patient care.[7] Consequently, simulation instructors may be uniquely placed to nurture self-efficacy, by furnishing nurses with the necessary motivation to create behavioural shifts that might then positively influence the individual, the team and the patient.

The downside to simulation

Despite these reported benefits, there are potential weaknesses of simulation. This training modality is often extremely expensive, time consuming and resource intensive and it may present practical challenges in terms of finding appropriate physical space. For the learner, the suspension of disbelief can sometimes be difficult and this may reduce the realism of the simulated experience. There is a risk of cognitive overload for the participant, which may generate significant anxiety and even impede performance.[8-11] Furthermore, limited robust data exist about the transferability and durability of the attributes that are acquired through simulation. Common generalisations that suggest that simulation enhances patient safety, for example, are not easy to substantiate and strong qualitative and quantitative evidence is lacking. Indeed, the true impact of simulation is often difficult to measure in an empirical manner and we must, therefore, be wary of claims that simulation is the educational panacea that many perceive it to be.[12]

Simulation and patient safety in neonatal care

Despite these uncertainties, some argue that it is foolish to delay the widespread implementation of this educational methodology to a time when we have absolute proof of its validity.[1] The growing

need for a safer health service and the vulnerability of neonatal patients make simulation-based education an attractive option for stakeholders, managers and service providers. Simulation may help to address inadequate clinical competence and dysfunctional teams by providing the opportunity to rehearse critical clinical situations, thereby promoting safety and reinforcing standards.[13-15] Similarly, neonatal nurses require specialist knowledge and skills that are not typically found in newly qualified nurses[16] and simulation offers a potentially viable tool for the ongoing assessment and maintenance of competence.[17] Although studies exploring the impact of simulation in pre-registration nursing and other specialties exist, few relate to post-registration nursing or the neonatal field.

Methodology

This literature search was completed using the EBSCO Online Research Databases to explore ERIC (Education Resources Information Center), CINAHL Plus (Cumulative Index to Nursing and Allied Health Literature), British Education Index and e-journals, while EMBASE was accessed via the NICE Healthcare Database. Searches of the Cochrane library and PsycInfo were also performed. Boolean operators were applied to combine the search terms. On completion of the search process, abstracts for each paper were reviewed and full text articles and doctoral theses obtained to allow the literature to be manually sifted for relevance against the inclusion and exclusion criteria (**FIGURE 1**). Of the 88 papers identified, 22 duplicates and 48 papers that did not meet the inclusion criteria were removed. In this way, the final 18 articles for the review were identified.

Thematic development and application of a theoretical education framework

Thematic development is a complex multi-step technique whereby the repeated interrogation of the data yields new ways to interpret the literature.[18,19] For the purposes of this review, each of the final 18 papers was analysed using a data extraction grid[18] and the early themes were identified. These initial themes were then transposed into a table where the key words within each theme statement were highlighted and later grouped under headings within

The literature is more than 10 years old

The literature is not available in English

The literature does not include the teaching of neonatal skills through simulation

The literature has an obstetric/midwifery focus in relation to the skills that are taught

The literature does not include post-registration nurses in the sample

The literature is not peer-reviewed

The literature is a conference abstract

FIGURE 1 Criteria for exclusion.

Kirkpatrick's training evaluation model.[20] Kirkpatrick's model offers a tool to evaluate the impact of training and the four levels he describes are:
1. *Reaction* – this relates to the impact for the individual learner and how participants respond, including what they think and feel about the training.
2. *Learning* – this refers to the resulting knowledge and capability that is acquired as part of the learning process.
3. *Behaviour* – this involves the changes in behaviour for the participant and the wider team, including how the learning is applied.
4. *Results* – this includes the impact of learning on the service or organisation, including time, cost and other resources.
   This reductive process of data extraction and synthesis ultimately resulted in the formation of nine themes (**FIGURE 2**) and the incidence of each within the final 18 papers is charted in **FIGURE 3**.

An exploration of the theme of self-efficacy and confidence within the literature

The concepts of self-efficacy and confidence were frequently cited, featuring in 12 of the papers in this review. Bandura[6] suggests that the process of becoming skilled and the achievement of success have a profound impact on self-efficacy. Conversely, inadequate performance or failure will reduce self-efficacy.[10] By allowing nurses the opportunity to rehearse and succeed at simulated skills, performance anxiety may be reduced and self-efficacy and confidence increased.[10,21,22]

Weiner et al[23] tested this notion by conducting a randomised controlled study to evaluate self-confidence levels in nurses attending a self-directed neonatal resuscitation programme (NRP) compared to a traditional classroom-based course. A total of 46 nurses, with responsibility for newborn care, were allocated to one of these two groups and this assignment determined the pre-course activities,

1. Learner satisfaction
2. Education theory
3. Knowledge and skill acquisition
4. Debriefing
5. Self-efficacy and confidence
6. Teamwork
7. Resources
8. Patient outcome and safety
9. Maintaining competency

FIGURE 2 The nine identified themes.

programme content and instructor contact time for each subject. Self-confidence scores were calculated from questions within the course evaluation and these were based on a Likert scale. The results appeared to slightly favour the classroom-based group although this difference was not quite significant (p=0.05) and the self-confidence score was not indicative of overall performance. This proclivity toward the traditional classroom-based approach might have occurred because this format felt more familiar to the participants. In addition, the greater instructor contact time may have contributed to the perceived increase in self-confidence in this group.

Hensel et al[24] also compared two different methods of simulation delivery, within the NRP. The authors hypothesised that the post-registration nurses attending this course would feel more confident if they observed the final competency assessment performed by peers (student nurses) compared to those who watched a DVD that included NRP instructors.[26] Data relating to confidence was obtained using the National League for Nursing (NLN) Self-Confidence in Learning instrument, which required a score from 1 (strongly disagree) to 5 (strongly agree) for eight items. Overall, learner confidence was high but this did not vary significantly between the student and instructor DVD groups.[24] Hensel et al chose to describe the pre-registration student nurses as peers to the experienced post-registration neonatal

nurses. However, this assumption may be somewhat flawed as these specialist nurses may not consider the unqualified novice nurse as a peer.

Square[25] also conducted an empirical study to explore the impact of simulation on nursing self-confidence. Her unpublished but peer-reviewed doctoral research included a sample of 48 neonatal intensive care nurses who were assigned to either an experimental group that included exposure to a high-fidelity simulation within the STABLE programme or to a control group without simulation (the STABLE course explores key principles of neonatal care and stabilisation, including Sugar, Temperature, Airway, Blood pressure, Lab work and Emotional support). Like Hensel et al,[24] Square utilised the NLN Self-Confidence in Learning scale to assess reported confidence levels four weeks after the course. Although the mean post-test score was higher for subjects who completed the simulation, this was not statistically significant. Previous nursing experience did not appear to impact on self-confidence.

It is worth noting that in each of the studies by Weiner, Hensel and Square et al,[23-25] the simulation activity was directly linked to a mandated neonatal course, which may have influenced reported confidence levels. The professional expectations associated with such programmes may cause participants to respond in a particular way.[26,27]

Singhal et al[28] published an evaluation of a neonatal simulation-based programme, known as Acute Care of at-Risk Newborns (ACoRN), relating to post-resuscitation management of infants. The purpose of their study was to assess the transferability of the course from Canada to China and to assess its impact on learner confidence.

This was measured using a pre- and post-test questionnaire, which showed good reliability. A total of 216 doctors and nurses from 15 hospitals in an economically disadvantaged province of China took part. A statistically significant increase in learner confidence scores was demonstrated and this correlated significantly with knowledge.

In contrast, Walker et al[27] showed a poor correlation between knowledge and self-efficacy within their study, despite significant increases in self-efficacy scores for the 450 medical and nursing staff that attended a neonatal and obstetric skills-based simulation programme called PRONTO. A total of 24 Mexican hospitals took part in this research. Pre- and post-test self-efficacy questionnaires required subjects to rate themselves for 88 questions. The seemingly low correlation between self-efficacy and knowledge could

	1. Reaction	2. Learning			3. Behaviour		4. Results		
	Learner satisfaction	Education theory	Knowledge and skill acquisition	Debriefing	Self-efficacy and confidence	Teamwork	Resources	Patient outcome and safety	Maintaining competency
Lemoine & Daigle[21]					✔			✔	
Raines[22]					✔			✔	
Weiner et al[23]	✔				✔		✔		
Hensel et al[24]	✔	✔			✔				
Square[25]	✔	✔	✔		✔	✔			
Faraci[26]		✔			✔				
Walker et al[27]			✔		✔	✔	✔		
Singhal et al[28]			✔		✔				
Brown et al[29]					✔				
Reinarz[30]		✔		✔	✔				✔
Lindamood & Weinstock[31]		✔	✔	✔	✔		✔		
Cooper[32]	✔	✔	✔	✔	✔	✔	✔	✔	
Rakshasbhuvankar & Patole[34]							✔	✔	
LeFlore & Anderson[35]	✔	✔	✔		✔				
Sawyer et al[36]			✔			✔		✔	
Yaeger & Arafeh[37]		✔		✔					
Cates & Wilson[38]		✔		✔				✔	
Fawke & Cusack[39]		✔		✔			✔		
Frequency of sub-theme	**5**	**10**	**7**	**6**	**12**	**5**	**6**	**6**	**1**

FIGURE 3 The incidence of each theme within the final 18 papers categorised within the context of Kirkpatrick's (2006) training evaluation model.

indicate a potential response bias since subjects might register enhanced self-efficacy scores because of a perceived professional expectation that they should do so. Interestingly, Walker et al reported lower pre-test self-efficacy scores for nurses compared to medics. They suggest that doctors might overstate their professional capabilities prior to simulation-based training and this could explain the reduced gain in self-efficacy for medics.

Brown et al[29] also report increased confidence among medical and nursing staff, following attendance at the Advanced Resuscitation of the Newborn Infant (ARNI) course. This nationally recognised programme, accredited by the Resuscitation Council UK, uses simulation-based training to explore communication, team working and human factors. Following ethics approval, 32 experienced doctors and nurses, with responsibility for newborn resuscitation, were asked to complete pre- and post-course questionnaires to evaluate their perceived self-efficacy and effectiveness. In addition, semi-structured interviews were held 6-12 months after the course to gather qualitative data. The authors acknowledge the small sample size and statistical analysis is not included within the published article. Baseline pre-course confidence scores for nurses were lower for areas that are typically beyond the nursing remit (eg intubation and leading a resuscitation) presumably because these skills are less familiar to them. Nonetheless, the authors conclude that, overall, the mean confidence scores were significantly higher post-course for both medical and nursing staff.

Reinarz[30] conducted a quality improvement project involving the simulation of needle thoracostomy by 18 neonatal nurse practitioners, from seven American neonatal units. For the purposes of this study, a 21-step written procedure guide for needle thoracostomy and an accompanying scoring system were created and approved by a panel of experts. Half of the subjects read this written procedure guide and watched a NRP instructor video prior to performing the simulated procedure, while the remaining participants were not given this opportunity. Following the simulation, each candidate received a debrief using a video of their performance. The debrief formed an integral part of the simulation experience, permitting the opportunity for candidates to review their procedural performance, evaluate their

competency and adapt their future practice, thereby promoting confidence.

Although this study received ethics approval there are limitations to the work. The small sample size meant that no measure of statistical significance was made and results were presented as mean scores or percentages. Recruitment was achieved through volunteers but such sampling techniques may skew results. Although participants were asked not to discuss the project with colleagues this was not monitored. Reinarz noted an increase in self-efficacy scores following the simulation, although the nurses who had the opportunity to read the procedure protocol and watch an NRP video reported lower post-test confidence.

Five of the 10 studies mentioned within Lindamood and Weinstock's[31] overview of simulation indicate increased confidence post-simulation, although these each had an obstetric or paediatric focus. Cooper[32] also alludes to a reciprocal relationship between simulation training, improved clinical performance and increased confidence within her integrative literature review, an idea that is echoed within the non-empirical work of Lemoine and Daigle[21] and Raines,[22] who suggest that it is the repeated opportunity to practice skills that enhances confidence.

Faraci[26] conducted a quasi-experimental study in California to determine the impact of high-fidelity simulation on self-efficacy in 35 neonatal intensive care nurses performing Paediatric Advanced Life Support (PALS). A pre- and post-test measure of self-efficacy was made using the Paediatric Advanced Life Support Appraisal Inventory (PALSAI).[26] This tool requires a score between 0 (completely lacking confidence) and 100 (highly confident) for 36 questions. The tool was validated by four independent experts and previously assessed for reliability. Computerised statistical packages were used to analyse the data.

Faraci's doctoral work concludes that simulation increases self-efficacy for PALS as there was a statistically significant increase in post-test self-efficacy scores for each parameter on the PALSAI instrument. However, completion of the PALSAI test relies on the self-reporting of self-efficacy levels by individual nursing staff. Since life support skills are an essential requirement for the neonatal nurse's role, it could be argued that participants felt obligated to report high confidence levels for this

critical skill. Faraci points out that subjects may also have underestimated their confidence levels prior to the simulation and that this could explain the gain in scores.

Limitations of the review

Although appropriate techniques were used, this literature search yielded very few quantitative studies, with only one randomised controlled trial. Therefore, many of the papers contain expert opinion, pilot studies and case reports, which might impact on the validity and generalisability of results. An element of heterogeneity also exists within the study design for some of the empirical studies, which may affect the inferences that can be made. For practical reasons, only articles available in English were included within this review but this might constitute a potential bias with the possible omission of valuable data. The bulk of the studies in this review are conducted in America and this may also limit the transferability of the results to other countries.

An inherent gender bias is not uncommon in research involving nurses since females frequently dominate the study population. It is important to acknowledge that studies with favourable results are more likely to be published so an inevitable bias may, therefore, exist within this review.[33] Although the use of multiple reviewers was not an option for this work, such an approach would most likely enhance the credibility of the process of data evaluation and thematic evolution.

Conclusion

Although further robust quantitative research is needed, the studies within this review reveal a positive correlation between neonatal simulation experiences and improved confidence and self-efficacy among qualified nurses. These gains do not always correlate with prior experience or knowledge and nursing self-efficacy scores are generally lower than those of medics. By increasing self-efficacy, simulation training has the capacity to influence a nurse's ability to perform a particular skill. This could, in theory, positively impact future standards and performance but there is insufficient robust data to substantiate this assumption at present.

The need for further impact studies is particularly important given that simulation training requires a significant investment of money, equipment, time and personnel. In the current financial climate,

it is essential that neonatal simulation studies move beyond the impact on the individual to examine the influence on Kirkpatrick's later levels of evaluation, including the team, patient outcome and service delivery. It is only by rigorously evaluating the return on investment for this educational methodology that the worth of neonatal simulation training for post-registration nurses can be reliably assessed.

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