

Learning by simulation in prehospital emergency care – an integrative literature review

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Background: Acquiring knowledge and experience on high-energy trauma is often difficult due to infrequent exposure. This creates a need for training which is specifically tailored for complex prehospital conditions. Simulation provides an opportunity for ambulance nurses to focus on the actual problems in clinical practice and to develop knowledge regarding trauma care. The aim of this study was to describe what ambulance nurses and paramedics in prehospital emergency care perceive as important for learning when participating in simulation exercises.

Methods: An integrative literature review was carried out. Criteria for inclusion were primary qualitative and quantitative studies, where research participants were ambulance nurses or paramedics, working within prehospital care settings, and where the research interventions involved simulation.

Results: It was perceived important for the ambulance nurses' learning that scenarios were advanced and possible to simulate repeatedly. The repetitions contributed to

increase the level of experience, which in turn improved the patients care. Moreover, realism in the simulation and being able to interact and communicate with the patient were perceived as important aspects, as was debriefing, which enabled the enhancement of knowledge and skills. The result is presented in the following categories: *To gain experience*, *To gain practice* and *To be strengthened by others*.

Conclusion: Learning through simulation does not require years of exposure to accident scenes. The simulated learning is enhanced by realistic, stressful scenarios where ambulance nurses interact with the patients. In this study, being able to communicate with the patient was highlighted as a positive contribution to learning. However, this has seldom been mentioned in a previous research on simulation. Debriefing is important for learning as it enables scrutiny of one's actions and thereby the possibility to improve and adjust one's caring. The effect of simulation exercises is important on patient outcome.

Keywords: accident and emergency, acute care, advanced nursing practice, clinical nurse specialist, emergency, paramedical care.

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Introduction

In this article, we highlight the factors that influence learning during simulation exercises within prehospital care. For the purposes of this study, paramedics are grouped with ambulance nurses and referred to as ambulance nurses.

Prehospital emergency care includes a wide range of medical conditions, from minor injuries to life-threatening emergencies. Therefore, interventions required to stabilise the patient range from basic first aid to advanced emergency care. The complexity of the situation is

increased by the remote setting in which the care is taking place (1). The complexity of patient care resulting from high-energy trauma frequently requires highly trained ambulance nurses (2). An ambulance nurse needs to be able to assess the patient and the situation within seconds on arrival at the scene of an accident (3). However, these patients represent a small portion of the total number of prehospital patients. In the United Kingdom and Scandinavia, only 20–50 patients per 100 000 inhabitants suffer from high-energy trauma (4, 5). Without opportunity for regular contact with patients exposed to high-energy trauma, ambulance nurses have limited means to use and develop their skills. Consequently, acquiring knowledge and experience on high-energy trauma can be difficult (3, 6, 7). In the long term, this can result in increasingly limited knowledge and practical experience. This further increases the need for

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individually tailored training regarding complex and demanding prehospital conditions (6–9).

The level of skills required by prehospital ambulance nurses when caring for patients with high-energy trauma has long been a subject for discussion (10) and is so still. WHO (11) argues that all the member states of the European Union should introduce and regulate specialist training in prehospital emergency care. Furthermore, WHO argues that the member states should monitor and guarantee the quality of prehospital emergency care and that all emergency care should be performed by medical experts, including ambulance nurses (11).

In order to enhance the quality of care for severely injured patients in a rapidly changing health care environment, such as the prehospital context, ambulance nurses need opportunity to train and to learn. This enables them to be responsible for complex, clinical emergency situations while ensuring a high degree of patient safety (12–16). When the patient care is based on reflections on existing knowledge, the learning advances into experience (12, 17). By practising in a range of pre-hospital caring situations in varying environments, ambulance nurses learn to handle future situations. While the patient is still being cared for in a certain situation, learning in one context can be exchanged for another (18, 19). Awareness of the complexity of a situation is important for the development of evidence-based knowledge (20). It is also important for the caring motive, which is the ethical act grounded in responsibility for the patient and the will to do well for another person (21–24).

Simulation exercises with manikins or actors can be a way to manage learning in the unique prehospital environment (25). By imitating a real patient situation, the simulation exercise aims to reproduce the real conditions in which the ambulance nurses work (26). Simulation exercises therefore provide an opportunity for ambulance nurses to focus on actual problems in clinical practice and to develop learning in the context of trauma care. A simulation scenario that mimics reality with various degrees of realism, from low to high fidelity, promotes the integration of problem-solving and clinical reasoning. Simulation in clinical environments challenges the ambulance nurses to critically analyse problems and to make decisions in a changing environment, often with limited or conflicting information (27). Further learning requires creativity, an important reason for encouraging ambulance nurses to use prior knowledge to get a grip of the situation in order to make an assessment (12, 27). Simulation exercises allow ambulance nurses to advance in pace with their own level of knowledge (28). Repeated simulation exercises carried out over time improve the ability to recall knowledge (29). During simulation exercises, learning takes place in a controlled environment which is safe for both the ambulance nurses and the

patients (30–32). This means that patients are not exposed to risk or injury, as the learning does not take place at the accident site (33). In all likelihood, the learning that occurs during simulation exercises involving patients exposed to high-energy trauma can be further strengthened by increased awareness and knowledge of certain aspects of the educational situation. The aim of this study was to describe what ambulance nurses and paramedics in prehospital emergency care perceive as important aspects for learning when participating in simulation exercises.

Methods

An integrative literature review, in accordance with Sandelowski et al. (34, 35) and Whittermore and Knafl (36), was carried out. In the integrative design, the findings are grouped in categories which reflect the aim, rather than according to the methods of analysis. This way, the research addresses different yet connecting questions, and qualitative and quantitative findings complement each other. The findings have a potential to lead to more comprehensive understanding, broader general knowledge and deeper understanding (34–36).

Search strategies

Carefully documented electronic searches inspired by Jadad et al. (37) and Oxman (38) were conducted in the databases CINAHL, PubMed and Scopus during the month of September 2014 (36, 38). Search terms that were used included the following: *emergency medical technicians, paramedic, manikin, simulation, ambulance and pre-hospital*. CINAHL included peer-reviewed journals. In order to get the same results in Scopus, the search was limited to articles. Further combinations of search terms were carried out with the words *ambulance nurse, nurse, emergency, trauma, model, anatomic, training, learning, education, concept, percept, attitude and experience* but generated no new references. The search utilised the Internet as well as reference lists of existing articles.

Selection

Criteria for inclusion were primarily qualitative and quantitative studies, where research interventions involved some sort of simulation exercises performed by ambulance nurses or paramedics within prehospital care settings. In addition, the studies were to be published before 30 June 2014 and be written in English. Exclusion criteria were literature reviews and non-peer-reviewed studies. The electronic search included all relevant literatures as suggested by Jadad et al. (37) and generated 1125 hits, of which 249 were duplicates, resulting in 876 articles to review. In order to identify studies that matched the aim and the

inclusion criteria of the review, two persons independently read titles and abstracts. The disagreements were discussed until there was consensus. A total of 253 articles that were perceived as relevant were downloaded or ordered as full-text versions. The 253 retrieved articles were subsequently read in full by one reviewer (AA) to confirm the relevance to the purpose of the review and to ensure that the inclusion criteria were met. Consequently, out of the 253 articles, 7 met the inclusion criteria for the study. Five articles originated from CINAHL, published between 2001 and 2012. One article was identified in PubMed, published in 2007, and 1 article originated from Scopus, published in 2014 (Table 1).

Quality assessment

Subsequently, the seven articles were reread in full, and their content was evaluated by two reviewers (AA, and IR, BOS or LL). The evaluation of quality is complex, and according to Whittermore and Knafl (36) and Jadad et al. (37), there is no golden standard. For this evaluation, the guidelines for the quality assessment of quantitative and qualitative researches by Polit and Beck (39) were used. These guidelines were used in the initial assessment for determining the relevance to the aim and the inclusion criteria. The guidelines further provided a framework for assessment of the quality of the studies by identifying areas of adequacy and inadequacy and drawing conclusions about the overall body of evidence (39). All included articles reached the minimum quality criteria of 85% (39). The initial inter-rater agreement was 95% to 100% (399 of 420 subitems). The inter-rater disagreements were equally divided among the seven articles. The disagreements were discussed until there was 100% consensus (39).

Analysis

The systematic data analysis was conducted in accordance with Sandelowski et al. (34, 35) and Whittermore and Knafl (36). The findings from each study were grouped and thereafter divided into categories according to narrative findings that corresponded to the aim of the research. In this manner, the integration of findings made it possible

to create a comprehensive overview of all existing researches, regardless of the methodology (34–36).

Results

The ambulance nurses identified advanced scenarios and the opportunity to carry out simulations repeatedly as it is important for learning. Repetitions led to experience, which improved the patient care. Ambulance nurses noted that the important aspects of the simulations were realism and an opportunity to interact and communicate with the patients. Another important aspect was debriefing, which enhanced the knowledge and skills. The results are presented in the following categories: *To gain experience*, *To gain practice* and *To be strengthened by others* (for all studies see Table 2).

To gain experience

The simulation exercises were perceived as a meaningful training and an effective educational method (40–42). When the scenarios demanded more than the ambulance nurses were capable of performing, this in itself created a learning situation that promoted problem-solving abilities (43, 44). By repeating the scenarios, with or without variations, the ambulance nurses described that their learning increasingly became established experience (41, 42). The experience was described as important, as it provided benefits in practice (40–46). The ambulance nurses defined experience as a sense of comfort that encouraged self-confidence, which in turn resulted in improved patient care (42, 44, 45).

To gain practice

The experience of high-fidelity simulation scenarios heightened the anxiety levels among the ambulance nurses. The intensity of the experience was further amplified by the added surrounding noise and by the possibility of practising hands-on technical skills in a realistic context (41, 42, 46). The nurses perceived that the interaction with a physiologically accurate manikin, which responded to treatment, improved the knowledge and experience (40, 41, 43, 45, 46). The opportunity to communicate with the patient enhanced the realism and the learning experience (41, 42, 46). Learning through simulation was more effective than didactics or cadaver training, mainly due to the heightened realism in the high-fidelity scenarios (42, 44, 45). Manikins and live actors were also perceived as more effective for cognitive development and learning of practical skills (42, 46). However, virtual patients were only to a certain degree perceived as realistic due to the perception that actual patients generally demanded a more complex intervention than the simulation exercises entailed (43).

Table 1 The selection process

Database	Number of hits	Full article retrieved and reviewed	Included
CINAHL	696	178	5
PubMed	190 (79*) = 111	51	1
Scopus	239 (170*) = 69	24	1
Total number of articles	1125 (249*) = 876	253	7

*Duplicates.

Table 2 Presentation of the included studies

Author	Aim	Methods	Study population	Result
Alinier et al. (2014)	To explore whether simulation improved trainees' perception about multiprofessional working	Pre- and postexperience questionnaire using Likert scale. Statistical calculations performed with SPSS	237 students from nursing specialties, such as adult, paediatric, paramedic and pharmacy	They are benefited from watching peers and learning alongside a multidisciplinary team
Bond et al. (2001)	To ascertain the level of acceptance of a human patient simulator as a training tool. Also to elucidate its most useful aspects for training and find ways to improve upon the simulation experience	Quantitative and qualitative satisfaction surveys consisted of a Likert scale and three questions for qualitative written feedback	78 participants consisting of physicians, nurse, prehospital nurse, paramedics, paramedic students, EMTs, medical students, physician assistant students and medical resident	Realism and the ability to see response to treatment were positive. Negative comments focused on logistics
Davis et al. (2007)	To measure confidence with airway management and the subjective experience of crew members exposed to the simulation training	Pre- and post-test with visual analogue scale. Statistical calculations performed with StatDirect	120 paramedics and flight nurses	Simulation improved confidence in airway management. Simulators were more effective than didactics or cadaver training for the cognitive and technical components
Hoadley (2009)	To determine whether participants using high-fidelity (HF) simulation were more satisfied with simulation design and learning and tested higher, cognitively and behaviourally, at the end of the course than those who used low-fidelity simulation	An experimental, two-group design with pre- and post-test	53 participants consisting of physicians, nurses, respiratory therapists, advanced practice health care providers and medics at the basic, intermediate and paramedic levels	The HF group did score higher on cognitive and behavioural tests, but the results were not statistically significant. Both groups indicated satisfaction with their forms of simulation experience and course design
Kim et al. (2012)	Surveying participants' attitudes towards high-fidelity (HF) medical simulation	Pre- and postquestionnaire measured with visual analogue scale. A paired samples two-tailed <i>t</i> -test	13 participants consisting of physicians, Registered Nurses, licensed vocational nurse, EMT and paramedics	HF simulation improved acceptance of simulation as a training method. Realism of simulation improved self-confidence in knowledge and experience
Wilkerson et al. (2008)	To understand the possible utility of immersive virtual reality simulation for training first responders in a mass casualty event	Structured interviews	12 paramedics	The simulation was perceived as realistic and intense. Surrounding sounds and interaction were perceived as experience building
Wyatt et al. (2007)	A structured evaluation of the Laerdal SimMan Patient Simulator. Determine the 'functional fidelity' of a patient simulator from the paramedics' perspective	Quantitative evaluation form	113 paramedics	Simulation as an educational experience was held in high regard with physiological accuracy and beneficial to practice

Nevertheless, the overall level of realism was seen as a positive aspect for the ambulance nurses' cognitive and behavioural learning (44).

Generally, ample time was required for the orientation regarding the simulation scenario and its

environment. The ambulance nurses perceived it important for the learning that sufficient time to perform each scenario was allotted (40, 41, 43). The accuracy of manikin features related to tasks not generally carried out by the ambulance nurses in real

life was ranked with a low level of realism. However, these same features were ranked with increased comfort and higher levels of realism after the ambulance nurses had carried out the tasks in the simulation exercises (45, 46).

Being strengthened by others

Debriefing following a performed scenario was highlighted as important for learning, as it enabled scrutiny and questioning of one's own as well as the teams' performed actions. Personal strengths and weaknesses were identified through input from the instructor and peers who had taken part in or observed the simulation exercise. This gave an opportunity to improve and adjust knowledge and skills regarding both strengths and weaknesses. The ambulance nurses felt that this promoted their learning (41, 43, 44, 46).

Discussion

This study shows that a high sense of realism during simulation exercises engaged the ambulance nurses in the same way as a real-life patient encounter would, something which is also supported by Rudolph et al. (47). In a previous research, high realism has similarly been identified as effective in educational situations (15). In comparison, simulation exercises with low realism do not engage the ambulance nurses on an emotional level (14, 31, 48, 49). However, in contrast to our results, other studies have shown more learning effects from low-fidelity simulations (15, 50). Regardless of high- or low-fidelity contexts, it is essential to find ways to further enhance learning (51) and to enhance integration of learning into established experience for the ambulance nurses. When simulation exercises were repeated, the ambulance nurses increased their experience while retaining existing knowledge (29). Through experience, patient care is customised, and guidelines from books and recommendations can be put aside in the unique situation (52). The learning is then reflected in the actual treatment in clinical practice (33). Consequently, patient care and patient safety are improved.

The interaction with the patient (manikin) through two-way communication was highlighted by the ambulance nurses as a positive contribution to the learning situation. Communication between the ambulance nurse and the patient, however, is seldom mentioned in a previous simulation research, as identified by Abelsson et al. (7). The simulated emergency care often focuses on information about vital signs (53, 54) rather than communication with the patient. It might be that simulation exercises with a manikin do not provide for the same emotional and physical experience as does the caring for a real-life patient. The participants tend to forget to communicate with the manikin when they are more focused on

execution (53, 54). This can potentially lead to an absence of a relationship between the ambulance nurse and the patient. However, similar to the practice of technical skills, this communication and relationship with the patient may well be practised in a controlled simulated environment (55). Training in conducting assessments in such a manner can help ambulance nurses to maintain a more sensitive and open and exploratory attitude (56).

In order to maximise the learning outcome in simulation exercises, debriefing is an essential step, which was also confirmed by Bredmose et al. (3) and Weller (25). Debriefing aims at enhancing clinical skills, learning outcomes and competence development (57). During the debriefing, the participants select the information they need in order to build new knowledge. The new knowledge is integrated with their prior knowledge (58). An instructor highlighting correct and incorrect actions also helps ambulance nurses to learn. In such debriefing, correct care is confirmed and corrections of mistakes are enabled. This finding is consistent with that of others (29, 30, 57). With input from peers, the ambulance nurses were better able to identify their strengths and weaknesses. They could better reflect on their performance, a process which enables, through integrating new knowledge, a reconstruction of their theoretical frameworks. Most importantly, debriefing gave the opportunity to discover the relationship between clinical interventions and patient outcome (59). This study highlights the importance of finding ways to further enhance and transform learning into the established experience on behalf of the ambulance nurse.

Limitations

A limitation is that the retrieved studies were evaluated by only one researcher, which creates a risk of bias. To prevent this, in occasions of uncertainty, the studies were discussed among all four authors. For the purposes of this article, ambulance nurses and paramedics are presented as one profession. Therefore, an obvious limitation relates to those countries that assign meaning to and categorise each profession differently. In addition, the two professions draw on different health care training across countries. Yet another limitation is that, in 60% of the articles, other professions in addition to prehospital staff were included. However, as the aim of the research was to describe what was perceived as important for enhanced learning in simulation training, these articles were included.

Conclusion

Learning through simulation does not require years of exposure to accident scenes. The simulated learning is enhanced by realistic, stressful scenarios where ambulance nurses interact with patients. In this study, being able to communicate with the patient was highlighted as

a positive contribution to learning, whereas this is seldom mentioned in previous research. Debriefing is important for learning, as it enables scrutiny of one's actions and therefore the possibility to improve, evaluate and re-evaluate the caring act.

Competing interests

The authors declare that they have no competing interests.

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References

- 1 IBTPHEM. *Sub-Specialty Training in Pre-hospital Emergency Medicine. A Guide for Trainees, Trainers, Local Education Providers, Employers and Deaneries*. 2012, Intercollegiate Board for Training in Pre-hospital Emergency Medicine, London.
- 2 Steinemann S, Berg B, Skinner A, DiJulio A, Anzelon K, Terada K, Oliver C, Chih Ho H, Speck C. In situ, multidisciplinary, simulation-based teamwork training improves early trauma care. *J Surg Educ* 2011; 68: 472–7.
- 3 Bredmose P, Habig K, Davies G, Grier G, Lockey DJ. Scenario based outdoor simulation in pre-hospital trauma care using a simple mannequin model. *Scand J Trauma Resusc Emerg Med* 2010; 18: 1–6.
- 4 National Audit Office. *Major Trauma Care in England*. 2010, The Stationery Office, London.
- 5 Kristiansen T, Søreide K, Ringdal KG, Rehn M, Kru JK, Reite A, Melting T, Næss PA, Lossius HM. Trauma systems and early management of severe injuries in Scandinavia: review of the current state. *Injury* 2010; 41: 444–52.
- 6 Abelsson A, Lindwall L. The Prehospital assessment of severe trauma patients' performed by the specialist ambulance nurse in Sweden – a phenomenographic study. *Scand J Trauma Resusc Emerg Med* 2012; 20: 1–8.
- 7 Abelsson A, Rystedt I, Suserud BO, Lindwall L. Mapping the use of simulation in prehospital care – a literature review. *Scand J Trauma Resusc Emerg Med* 2014; 22: 1–12.
- 8 Lindblad C, Sjöström B. Battlefield emergency care: a study of nurses' perspectives. *Accid Emerg Nurs* 2005; 13: 29–35.
- 9 Söderström E, vanLaere J, Backlund P, Maurin Söderholm H. Combining work process models to identify training needs in the pre-hospital care process. In *Perspectives in Business Informatics Research*. (Johansson B, Andersson B, Holmberg N eds), 2014, Springer, Lund, 375–89.
- 10 Liberman M, Mulder D, Sampalis J. Advanced or basic life support for trauma: meta-analysis and critical review of the literature. *J Trauma* 2000; 49: 584–99.
- 11 WHO. *Emergency medical services system in the European Union. Report of an assessment project co-ordinated by the World Health Organization*. 2008. http://www.euro.who.int/_data/assets/pdf_file/0003/114564/E92039.pdf
- 12 Benner P, Sudgen M, Leonard V, Day L. *Educating Nurses: A Call for Radical Transformation*. 2010, Jossey-Bass, San Francisco.
- 13 Murphy S, Hartigan I, Walshe N, Flynn AV, O'Brien S. Merging problem-based learning and simulation as an innovative pedagogy in nurse education. *Clin Simul Nurs* 2011; 7: 141–8.
- 14 Gaba DM. The future of vision of simulation in health care. *Qual Saf Health Care* 2004; 13: 2–10.
- 15 Issenberg SB, McGaghie WC, Petrusa ER, Gordon DL, Scalese RJ. Features and uses of high-fidelity medical simulations that lead to effective learning: a BEME systematic review. *Med Teach* 2005; 27: 10–28.
- 16 Myrick F. Educating nurses for the knowledge economy. *Int J Nurs Educ Scholarsh* 2005; 2: 1–9.
- 17 Schön D. *The Reflective Practitioner: How Professionals Think in Action*. 1983, Ashgate, Aldershot.
- 18 Benner P, Hooper-Kyriakidis P, Stanard D. *Clinical Wisdom and Interventions in Acute and Critical Care, Second Edition: a Thinking-in-Action Approach*. 2011, Springer, New York.
- 19 Marton F, Booth S. *Om lärande (About learning)*. 2000, Studentlitteratur, Lund.
- 20 Benner P. *From Novice to Expert: Excellence and Power in Clinical Nursing Practice*. 2001, Prentice Hall, New Jersey, USA.
- 21 Eriksson K. Nursing science in a Nordic perspective. Systematic and contextual caring science. A study of the basic motive of caring and context. *Scand J Caring Sci* 1990; 4: 3–20.
- 22 Eriksson K. Caring Science in a New Key. *Nurs Sci Q* 2002; 15: 61–5.
- 23 Levinas E. (Hand S ed). *The Levinas Reader*. 1989, Blackwell, Oxford.
- 24 Levy-Malmberg R, Eriksson K, Lindholm L. Caritas – caring as an ethical conduct. *Scand J Caring Sci* 2008; 22: 662–7.
- 25 Weller JM. Simulation in undergraduate medical education: bridging the

Author contributions

AA conducted the literature search, analysed the material and wrote the manuscript. IR, BOS and LL supervised the literature search, were the additional assessors and supervised the analysis of the material and the writing of the manuscript. All authors read and approved the final manuscript.

Ethical approval

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- gap between theory and practice. *Med Educ* 2004; 38: 32–8.
- 26 Lammers R, Davenport M, Korley F, Griswold-Theodorson S, Fitch MT, Narang AT, Evans LV, Gross A, Rodriguez E, Dodge KL, Hamann CJ, Robey WC. Teaching and assessing procedural skills using simulation: metrics and methodology. *Acad Emerg Med* 2008; 15: 1079–87.
 - 27 Kim S, Phillips W, Pinsky L, Brock D, Phillips K, Keary J. A conceptual framework for developing teaching cases: a review and synthesis of the literature across disciplines. *Med Educ* 2006; 40: 867–76.
 - 28 West C, Usher K, Delaney L. Unfolding case studies in pre-registration nursing education: lessons learned. *Nurse Educ Today* 2012; 32: 576–80.
 - 29 Larsen DP, Butler AC, Roediger HL. Test-enhanced learning in medical education. *Med Educ* 2008; 42: 959–66.
 - 30 Jefferies P. Designing, implementing and evaluating simulations used as teaching strategies in nursing. *Nurs Educ Perspect* 2005; 26: 96–103.
 - 31 Lane JL, Slavin S, Ziv A. Simulation in medical education: a review. *Simul Gaming* 2001; 32: 297–314.
 - 32 Woolley NN, Jarvis Y. Situated cognition and cognitive apprenticeship: a model for teaching and learning clinical skills in a technologically rich and authentic learning environment. *Nurse Educ Today* 2007; 27: 73–9.
 - 33 Kardong-Edgren S, Adamson KA, Fitzgerald C. A review of currently published evaluation instruments for human patient simulation. *Clin Simul Nurs* 2010; 6: 25–35.
 - 34 Sandelowski M, Voils CI, Barroso J. Defining and designing mixed research synthesis studies. *Res Sch* 2006; 13: 1–15.
 - 35 Sandelowski M, Voils C, Barroso J. Comparability work and the management of difference in research synthesis studies. *Soc Sci Med* 2007; 64: 236–47.
 - 36 Whittermore R, Knafl K. The integrative review: updated methodology. *J Adv Nurs* 2005; 52: 546–53.
 - 37 Jadad A, Moher D, Klassen T. Guides for reading and interpreting systematic reviews: II. How did the authors find the studies and assess their quality? *Arch Pediatr Adolesc Med* 1989; 152: 812–7.
 - 38 Oxman AD. Systematic reviews: checklists for review articles. *Br Med J* 1994; 309: 648–51.
 - 39 Polit DG, Beck CT. *Nursing research; Generating and Assessing Evidence for Nursing Practice*. 2012, Lippincott, Philadelphia.
 - 40 Alinier G, Harwood C, Harwood P, Montague S, Huish E, Ruparelia K, Antuofermo M. Immersive clinical simulation in undergraduate health care interprofessional education: knowledge and perceptions. *Clinical Simulation In Nursing* 2014; 10: 205–16.
 - 41 Bond WF, Kostenbader M, McCarthy JF. Prehospital and hospital-based health care providers' experienced with a human patient simulator. *Prehosp Emerg Care* 2001; 5: 284–7.
 - 42 Davis DP, Buono C, Ford J, Paulson L, Koenig W, Garrison D. The effectiveness of a novel, algorithm-based difficult airway curriculum for air medical crews using human patient simulators. *Prehosp Emerg Care* 2007; 11: 72–9.
 - 43 Wilkerson W, Avstreih D, Gruppen L, Beier KP, Woolliscroft J. Using immersive simulation for training first responders for mass casualty incidents. *Acad Emerg Med* 2008; 15: 1152–9.
 - 44 Hoadley TA. Learning advanced cardiac life support: a comparison study of the effects of low- and high-fidelity simulation. *Nurs Educ Perspect* 2009; 30: 91–5.
 - 45 Kim YM, Kang HG, Kim JH, Chung HS, Yim HW, Jeong SH. Direct versus video laryngoscopic intubation by novice prehospital intubators with and without chest compressions: a pilot manikin study. *Prehosp Emerg Care* 2011; 15: 98–103.
 - 46 Archer F, Wyatt A, Fallows B. Use of simulators in teaching and learning: paramedics' evaluation of a Patient Simulator. *AJP* 2007; 5: 1–16.
 - 47 Rudolph JW, Simon R, Raemer DB. Which reality matters? questions on the path to high engagement in healthcare simulation. *Simul Healthc* 2007; 2: 161–3.
 - 48 Pike T, O'Donnell V. The impact of clinical simulation on learner self-efficacy in pre-registration nursing education. *Nurse Educ Today* 2010; 30: 405–10.
 - 49 Scalese R, Obeso V, Issenberg S. Simulation technology for skills training and competency assessment in medical education. *J Gen Intern Med* 2007; 23: 46–9.
 - 50 Beaubien JM, Baker DP. The use of simulation for training teamwork skills in health care: how low can you go? *Qual Saf Health Care* 2004; 13: 51–6.
 - 51 Dieckmann P, Gaba D, Rall M. Deepening the theoretical foundations of patient simulation as social practice. *Simul Healthc* 2007; 2: 183–93.
 - 52 Östlinder G, Norberg A, Pilhammar-Andersson E, Öhlén J. *Erfarenhetsbaserad kunskap: Vad är det och hur värderar vi den?* 2006, Svensk sjuksköterskeförening, Stockholm.
 - 53 McCaughey CS, Traynor MK. The role of simulation in nurse education. *Nurse Educ Today* 2010; 30: 827–32.
 - 54 Yuan HB, Williams BA, Fang JB. The contribution of high-fidelity simulation to nursing students' confidence and competence: a systematic review. *Int Nurs Rev* 2011; 59: 26–33.
 - 55 Webster D, Seldomridge L, Rockelli L. Making it real: using standardized patients to bring case studies to life. *J Psychosoc Nurs Ment Health Serv* 2012; 50: 36–41.
 - 56 Wireklint Sundström B, Dahlberg K. Being prepared for the unprepared: a phenomenology field study of Swedish prehospital care. *J Emerg Nurs* 2012; 38: 571–7.
 - 57 McGaghie WC, Issenberg B, Petrusa ER, Scalese RJ. A critical review of simulation-based medical education research: 2003–2009. *Med Educ* 2010; 44: 50–63.
 - 58 Clark RC, Mayer RE. Learning by viewing versus learning by doing: evidence-based guidelines for principled learning environments. *Perform Improv* 2008; 47: 5–13.
 - 59 Walshe N, O'Brien S, Murphy S, Hartigan I. Integrative learning through simulation and problem-based learning. *Clin Simul Nurs* 2013; 9: 47–54.