Teaching basic life support to the digital generation: randomized trial comparing video-assisted versus practical simulation

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SUMMARY

- Simulation is a teaching method used to facilitate learning of Basic life support and Defibrillation (BlsD) techniques. This study explored the potential of two ways of teaching BlsD techniques in order to understand which one could be the best between Low-Fidelity Simulation and Moderate-Fidelity Simulation.
- A sample (n = 127) of nursing students was selected for this two group pre- post- test conveniently randomized design with 4-month follow up to compare two methods of simulation teaching.
- Students were allocated to Low-Fidelity (LF) (n = 64) and Moderate-Fidelity (MF) (n = 63) simulation teaching. Early evaluation immediate post intervention demonstrated an increase of knowledge in each group (LF mean pre test score = 44, immediate post test score = 62.18, MF mean pre test score = 42, immediate post test mean score = 62.18). Post-test 2 (4 months later) showed that there are no significant differences between the two groups in terms of knowledge retention (LF mean score = 65.81, MF mean score = 61.45. p = 0.721).
- Despite the limit of small sample size, the study showed that the two teaching methods are equally effective in acquisition and retention of information on BlsD techniques. However the low-fidelity method was more efficient and less resource intensive.

INTRODUCTION

Clinical simulation is defined as any activity that mimics a real clinical environment or situation. It is used to increase understanding of how to manage clinical situations without jeopardizing patients' safety (Jeffries, 2005; Morton, 1995). The use of simulation in nursing education has become more common as simulation technology has become more readily available, less expensive, more effective, and more popular (Seropian, Brown, Gavilanes, & Driggers, 2004).

Several researchers have tried to determine which variables most influence the degree of learning achieved through simulation (Dieckman, Gaba, & Rall, 2007; Issenberg, McGaghie, Petrusa, Gordon, & Scalese, 2005). Salas and Cannon-Bowers (2001) state that little is known regarding why simulation works.

Sudden cardiac death is a natural death due to cardiac causes, heralded by abrupt loss of consciousness within an hour of the onset of acute symptoms. Pre-existing heart disease may or may not have been previously recognized, but the time and the mode of death are unexpected (Priori & Zipes, 2006). The current annual incidence of sudden cardiac death in the United States is estimated to be in the range of 180,000 to 250,000 per year (Chugh et al., 2008) with event rates in Europe reported as similar to those in the United States (Priori & Zipes, 2006). Cardiopulmonary resuscitation training is mandatory for nursing staff and it is particularly important as nurses often discover the victims of in-hospital cardiac arrest (Hamilton, 2005). The present study aims to combine these issues in order to explore the potential of two different ways of teaching BlsD techniques to undergraduate nursing students. It focuses on the possible differences in terms of acquisition and retention of information arising from the use of a low-fidelity simulation (video assisted simulation) and a moderate-fidelity simulation (practical simulation) approach. Furthermore this study identified those students who have a history of witnessing and intervening in cases of cardiac arrest in their clinical practice. In summary, the research aimed to provide greater clarity as to whether or not BLS could be taught via video assisted simulation just as effectively as by moderate-fidelity simulation.

LITERATURE REVIEW

There is increasing interest in the use of non-traditional teaching methods in several fields of specialization and for various purposes. For example, a number of innovative methods, such as self-instruction have been employed to improve cardiopulmonary resuscitation (CPR) training (Batcheller, Brennan, Braslow, Urrutia, & Kaye, 2000; Done & Parr, 2002; Einspruch, Lynuch, Auderheide, Nichol, & Becker, 2007).

An extensive body of research shows that CPR knowledge and

skills decline rapidly following completion of a CPR course, while CPR psychomotor skills decline even more quickly (Hamilton, 2005 as cited in Oermann et al., 2010; Madden, 2006; Moser & Coleman, 1992). Conversely, Yeung et al. (2009) found that there was "good evidence supporting the use of CPR feedback/prompt devices during CPR training as a strategy to improve CPR skill acquisition and retention" (p.7). This indicates that new methods for training in basic life support (BLS) may be of benefit.

A study was conducted to evaluate the effectiveness of HeartCode™ BLS a self-directed, computer-based course to get the BLS certification. This study revealed that those students who trained using the computer-based course and practiced their CPR skills on a voice assisted manikin (VAM) were significantly more accurate in their ventilations, compressions and single-rescuer CPR than students who trained with an instructor (Oermann et al., 2010). In other studies, not only did the students perform with more accuracy but they also showed higher retention skills, which was attributed to the way that VAM gives verbal feedback and prompts during training (Cason et al. 2009; Wik et al. 2002). This means that HeartCode BLS with VAM can be considered a valid alternative to instructor led training, which provides flexibility and convenience while addressing a range of students learning needs (Oermann et al., 2010).

A potentially valuable tool in the process of retaining knowledge and skills is video-recording. It is thought that this tool could empower students with the skills for self-assessment, a critical ability in the process of lifelong learning. Vnuk et al. (2006) conducted a study to establish if students, after seeing their performance on video, would rank themselves with the same results as their instructors. The findings showed that viewing a recording of their performance did not improve the agreement of students' self-assessment with the instructors' assessment. Despite these results, using video recording could prove effective with the introduction of check-lists, viewing of benchmarking videos, and multiple opportunities for students to see their performance.

Schrader et al. have discussed the almost unrecognized educational potential of video games. They affirmed that both students and teachers use video games regularly and they can be adapted for educational purposes by creating a highly interactive virtual environment. For example, EMSAVE, a serious game developed for advanced life support (ALS) retraining, has proved to be effective in facilitating the retention of knowledge and skills. This game as also been considered to be stimulating and engaging by the course participants (Buttussi et al. 2013).

Distance learning is another potentially effective tool. Despite the level of controversy regarding simulations and effectiveness of Internet-based distance learning the use of specifically developed software to teach Pediatric Basic Life Support (PBLS) has shown good results in improving theoretical knowledge in medical students (De Assiss, Sigulem & de Carvalho, 2005). This software is accessible free-of-charge and has supported the spread of this knowledge all over the community at a limited cost.

With this substantial background in mind, we undertook to evaluate the difference in knowledge retention of final-year nursing students randomly allocated to a LF and MF learning group to see if there were any differences in the outcomes of such teaching techniques.

METHODS

A prospective two group pre- post- test randomized design with 4-month follow up was conducted to verify the research hypothesis, running from November 1, 2009, to February 28, 2010. This study was conducted in two Italian nursing schools. A sample (N=127) of undergraduate nursing students enrolled in first semester of the third and final year of the bachelor of nursing course were recruited on a voluntary basis. Half (64) were randomly allocated to the LF group and the rest (63) to the MF group. Randomization was created by allocating every second student on the student enrollment list to a different group. Consent was obtained from all participants. The study comprised three phases and institutional ethics approval was granted for this research study.

In the first phase all participants were invited to respond to two questionnaires. The first questionnaire sought information about their previous experiences:

• Have the students been involved in an educational course with the aim to develop knowledge and skills on BlsD techniques?

• How much do they feel prepared to face a sudden cardiac death event?

• How many episodes of sudden cardiac death did they witness during their clinical practice?

• What was the level of anxiety felt when confronted by a sudden cardiac death event?

• How much do they feel prepared in terms of skills to be able to manage an episode of sudden cardiac death?

A profile of experiences was to be examined based on responses to these questions.

The second questionnaire (see Figure 1) aimed to assess the participants' level of theoretical knowledge in relation to sudden cardiac death and the BlsD algorithm.

In the second phase of the study students were randomly separated in two groups: LF and MF. Both groups were involved in a teacher-centered, hour-long lecture on sudden cardiac death and BlsD procedures. In addition to the lecture the LF group attended a one-hour DVD session that showed and explained the entire BlsD sequence. The MF group instead took part in a simulation session using a Laerdal® ResusciAnne® manikin, a simulated defibrillator and a Hambu™ connected to a face mask. This one-hour simulation session was based on a demonstration of a complete BlsD sequence and was managed by a certified instructor with an instructor/student ratio of 1:4. Participants were then asked to rebuild the single-rescuer procedure one or more times within an allocated timeframe. At the end of the two-hour educational procedure both groups were retested with the second questionnaire used in phase one (post-test 1). The third phase of the study involved retesting all participants after a four-month interval, again using the second questionnaire delivered in phase one (post-test 2).

The data were compiled into Microsoft Office Access database. For the comparison of participant performance, the mean value of correct answers given in the administered tests was calculated. The data analysis aimed to determine whether statistically significant differences existed for the mean value within each group and between the two groups investigated.

For the comparative analysis between the two groups a Wilcoxon Rank Sum Test was adopted, as a non-parametric test for the two independent samples are drawn from a population with an ordinal distribution. While for the comparison of means within each group, a Wilcoxon Paired-Signed Rank Test was adopted (Lehmann 1975). The Wilcoxon Paired-Signed Rank test is even more sensitive than the Student t-test when we do not know that values are Normal distributed and the numbers involved are relatively low. The analyses were performed through SPSS 16.0 and probability (P) values below 0.05 were considered statistically significant throughout.

RESULTS

A total of 369 questionnaires were collected: 186 from the LF group and 183 from the MF group. The LF group questionnaires were administered as follows, 64 as pre-test, 64 as post-test 1 (immediately at the end of the educational path) and 58 as post-test 2 (four months

after the educational path). The MF group questionnaires were administered as follows, 63 pre-test, 62 post-test 1 and 58 post-test 2. There were no obvious differences in age or academic scores between the two groups and all were in their final year of a three-year bachelor degree in nursing. Similarly, there was no significant difference in history of exposure/witness to cardiac arrest, i.e., the witness history was equally distributed in the two groups.

Figure 1. Theoretical knowledge questionnaire

1) Basic Life Support algorithm includes:	a) early recognition of absence of consciousness, breath and circulation b) early access to get help c) early CPR in case of Sudden Cardiac Arrest d) all of the above are correct
2) Sudden cardiac death:	a) is the sudden loss of cardiac and respiratory function b) occurs in people with or without diagnosed cardiac disease c) can occur with or without warning signs or symptoms d) all of the above are correct
3) In the case of sudden cardiac death witnessed by professional health workers AED must be used:	a) after consciousness evaluation b) after having ensured patent airway c) after having performed 2 minutes of CPR d) after having checked breathing and other vital signs
4) In the case of sudden cardiac death not witnessed by professional health workers if AED is close to the victim:	a) 2 minutes of CPR must be performed b) check breathing and other vital signs then start analysis c) attach pads, perform the evaluations and possibly start analysis d) act at your discretion accordingly to the type of event
5) Which is the most frequent initial rhythm in sudden cardiac death?	a) ventricular tachycardia and ventricular fibrillation b) asystole c) PEA d) sinus rhythm
6) For how long must we perform CPR between the shock and the next analysis?	a) 1 minute b) 3 minutes c) 2 minutes d) 30 seconds
7) Which are the positions of pads in addition to the standard position accordingly to ERC/ILCOR guidelines ?	a) A pad must be attached on the left midaxillary line and the other one in the same position on the opposite side b) A pad must be placed anteriorly on cardiac apex (standard position) and the other one must be placed posteriorly on the left or right side of upper thorax c) A pad must be placed anteriorly on left precordium and the other one placed in the same way posteriorly medial to the left scapula d) All of the above are correct
8) The aim of BlsD algorithm is:	a) to ensure the early recognition of life threatening conditions b) to support ventilation and circulation c) to deliver shock if a shockable rhythm is present d) all of the above are correct
9) Why is it necessary to suspend CPR during AED analysis?	a) To prevent risk of electrocution b) To avoid artifacts c) To recognize if the victim starts to breath spontaneously and his heart beats normally d) To ensure an effective circulation
10) Which pulse are you able to take in the first 30 seconds in case of ventricular fibrillation ?	a) None b) Femoral c) Carotid d) Radial
11) Which of these statements regarding Heimlich maneuver is always incorrect:	a) it cannot be performed if the victim is unconscious b) it cannot be performed if the victim is affected by sudden cardiac arrest c) it facilitates the expulsion of a foreign body from airways d) first of all insert oro-pharyngeal airway

These learning tests were preceded by a preliminary evaluation of the real-life experience developed by the participants about sudden cardiac death and BlsD algorithm during their clinical practice. The results of real-life experience survey in the present study highlight that only 51% (65 of 127) of the students had witnessed a sudden cardiac death during their clinical practice (Table 1). Of those who had witnessed a sudden cardiac death the experience occurred in the following environments: surgical 31%, medical 36%, community services 2%, casualty and emergency department 6% and intensive care unit 25%. Among those who witnessed a sudden cardiac arrest, 75% had only the opportunity to observe what happened during the treatment. Furthermore, a small percentage (11%) performed chest compression, 3% were involved in the initial assessment, 2% of involved in ventilation of the patient and none of the students used the automated external defibrillator. Even in the "Chain of Survival", which is considered a key element in the BlsD sequence to ensure better opportunities of survival, the percentage of students responsible for its activation was only 20% (Table 1). The results for these background questions were not differentiated between LF and MF but were simply aggregated for the total group. Nevertheless, knowing this information, informs our knowledge of their experience and potential exposure to important learning experiences.

Previous involvement in BlsD courses (%)				
Yes	No			
83	17			
Witnessed episodes of sudden cardiac death (%)				
Never assisted	Less than 3 episodes	3 episodes	More than 3 episodes	
49	40	6	6	
Knowledge: self-assessment on sudden cardiac arrest basic concepts (%)				
Absolutely unprepared	Almost unprepared	Neither unprepared nor prepared	Quite prepared	Fully prepared
24	43	26	5	2
Anxiety: felt in managing patient affected by sudden cardiac death (%)				
Absolutely calm	Almost calm	Neither calm nor anxious	Anxious	Highly anxious
9	28	37	20	6
Competence: self-assessment - sudden cardiac arrest basic management (%)				
Absolutely competent	Almost competent	Neither incompetent nor competent	Quite competent	Fully competent
44	37	17	2	1

Table 1. Respondents' percentages on real-life experience investigation

Thus, it can be argued that for this reason, the majority (70%) of those students who were interviewed perceived a strong educational need related to this particular topic. This is emphasized by the percentage of students (26%) who experienced a medium-high to high anxiety in performing BlsD techniques.

The results from post-test 1 demonstrated a significant increase of knowledge in each group a mean score of 44 to 65.81 for the LF group and 42 to 65.81 for the MF group (p = 0.963) (see Table 2). Results of post-test 2, which was performed four months after the conclusion of the educational path showed that both groups had preserved the knowledge acquired at the end of the training and that there were no statistically significant differences between them in terms of knowledge retention (p = 0.721) (see Table 2).

	Low-fidelity group			Moderate-fidelity group			
	n	Mean score %	SD	n	Mean score %	SD	*p*
Pre-test	64	44	1.836	63	42	2.090	0.327
Post-test 1	64	62.18	1.748	62	62.18	2.074	0.963
Post-test 2	58	65.81	2.304	58	61.45	2.351	0.721

Table 2. Acquisition and retention knowledge: comparison between low and moderate-Fidelity groups in pre- and post-tests.

DISCUSSION

Non-traditional approaches to BlsD have been described earlier as has the need to find alternative ways to provide distance education and more efficient means of establishing competency and knowledge in BlsD (Batcheller, Brennan, Braslow, Urrutia, & Kaye, 2000; Done & Parr, 2002; Einspruch, Lynuch, Auderheide, Nichol, & Becker, 2007). In our study we have shown that there is no substantial difference in knowledge retention of BlsD between those who received LF and MF education and training, yet there is significant difference in resource allocation and time in LF simulation compared to MF simulation.

With ever growing pressure on academic and health care institutions to find more rational, cost effective means to improve productivity for less cost, this study demonstrates a simple example of how simulation can be used to effect the same outcome more efficiently.

Interestingly there is an immediate benefit in education demonstrated through the immediate post-test questionnaire compared to the pre-test questionnaire results. Furthermore we observed equally strong retention of knowledge between both LF and MF groups.

Unfortunately we were unable to separate out the previous experience results of the two groups to see if there were any differences in terms of past experience with exposure to educational courses with the aim to develop knowledge and skills on BlsD techniques, a history of witnessing or experiencing a sudden cardiac death event or feel prepared in terms of skills to be able to manage an episode of sudden cardiac death. Nevertheless this was a relatively inexperienced novice group, which could be assumed to have relatively equal naivety when it comes to responding to and managing BlsD events.

Limitations

The sample size of the present study and the lack of statistically significant differences in the findings suggest caution in concluding that the traditional approach based on the use of manikins can be replaced exclusively by multimedia training within undergraduate nursing courses. Moreover, only theoretical knowledge was investigated and no practical skills assessment was made on the examined population. Finally both groups gained familiarity and possible sensitization with the questionnaires as the same questionnaires were used for the pre test and the immediate post-test as well as the post-test 4 months after the intervention. Further research in this area is recommended, with an extension of the sample size and inclusion of clinical skills assessments in a clinical setting. It may also be useful to assess the real effectiveness of such educational paths in order to enhance outcomes in patients affected by sudden cardiac deaths.

CONCLUSION

E-learning, in its various forms, may represent a significant method of increasing abilities to perform BLS and ALS, as well as improving self-reported knowledge and confidence in providing CPR (O'Leary, 2011). Computer simulation games are an additional non-traditional teaching method that has proved to be beneficial in teaching critical thinking and historical analysis in secondary schools (McCall, 2011). The data analysis in the present study seems to support the hypothesis that video-assisted simulation, despite its environmental and psychological low-fidelity, is equivalent in terms of acquisition and retention of knowledge on BlsD, to practical simulation performed in a moderate-fidelity scenario, with the advantage of having a lower cost.

The findings of this study showed that the two teaching methods, LF simulation (video assisted simulation) and MF simulation (practical simulation) are equally effective in order to transfer the theoretical framework regarding sudden cardiac death and its treatment. On the basis of the data arising from the real-life experience survey, it would be useful to dedicate more time to the subject of sudden cardiac death and its algorithm of treatment by introducing simulated experience at various levels of fidelity and interactivity in undergraduate nursing education. If further research confirmed the results of the present study, a wide-scale introduction of this inexpensive and easily achievable teaching method would provide many advantages. However they should replicate this study with an eye on trying to mitigate some of the limitations of this study, specifically sensitization to a repeated test environment, background of subjects to experience with sudden death events and other training and exposure experiences.

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