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Review

A review of simulation-enhanced, team-based cardiopulmonary resuscitation training for undergraduate students

Arif Onan [a, *], Nurettin Simsek [b], Melih Elcin [a], Sevgi Turan [a], Bülent Erbil [c], Kaan Zülfikar Deniz [d]

[a] Department of Medical Education and Informatics, Hacettepe University, Faculty of Medicine, Sihhiye Campus, 06100 Altindag, Ankara, Turkey
[b] Department of Computer Education & Instructional Technology, Ankara University, Institute of Educational Sciences, 06590 Cebeci, Ankara, Turkey
[c] Department of Emergency Medicine, Hacettepe University Faculty of Medicine, Sihhiye Campus 06100 Altindag, Ankara, Turkey
[d] Graduate School of Educational Sciences, Ankara University, Institute of Educational Sciences 06590 Cebeci, Ankara, Turkey

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ABSTRACT

Cardiopulmonary resuscitation training is an essential element of clinical skill development for healthcare providers. The International Liaison Committee on Resuscitation has described issues related to cardiopulmonary resuscitation and emergency cardiovascular care education. Educational interventions have been initiated to try to address these issues using a team-based approach and simulation technologies that offer a controlled, safe learning environment. The aim of the study is to review and synthesize published studies that address the primary question "What are the features and effectiveness of educational interventions related to simulation-enhanced, team-based cardiopulmonary resuscitation training?" We conducted a systematic review focused on educational interventions pertaining to cardiac arrest and emergencies that addressed this main question. The findings are presented together with a discussion of the effectiveness of various educational interventions. In conclusion, student attitudes toward interprofessional learning and simulation experiences were more positive. Research reports emphasized the importance of adherence to established guidelines, adopting a holistic approach to training, and that preliminary training, briefing, deliberate practices, and debriefing should help to overcome deficiencies in cardiopulmonary resuscitation training.

1. Introduction

1.1. Background and context

Cardiovascular diseases are the main cause of death worldwide (3 out of every 10 deaths) and, 42% of these deaths are due to heart attacks (Mendis et al., 2011). Heart attacks increase the risk for sudden cardiac arrest. Sudden cardiac arrest is responsible for 10% of all deaths and up to 50% of heart disease–related deaths in the United States and other developed countries (Rea and Page, 2010). Emergent and skillful response during cardiopulmonary resuscitation (CPR) considerably raises patient survival rates, especially when it is administered outside of a hospital setting. The most important determinant of surviving a cardiac arrest is the presence of rescuers who are trained, willing, able, and equipped to act in an emergency situation. Resuscitation training is an essential element in clinical skill training for healthcare professionals (Soar et al., 2010). All healthcare professionals are expected to demonstrate competency in administering CPR. Therefore, educational practices should prove their effectiveness and ensure that the participants achieve the desired educational outcomes.

The International Liaison Committee on Resuscitation (ILCOR) has strongly emphasized that healthcare professionals must receive their initial training in basic life support (BLS) before their graduation. Nevertheless, many students cannot demonstrate mastery level CPR performance when they graduate. American Heart Association (AHA) states that training programs deteriorate rapidly if not offered frequently short-duration "refreshing" activities that prevent decay and improves acquisition and retention of CPR skills (Meaney et al., 2013).

In the case of cardiac arrest in hospital setting, nurses are

* Corresponding author.
E-mail addresses: aonan@hacettepe.edu.tr (A. Onan), nurettin.simsek@ankara.edu.tr (N. Simsek), melcin@hacettepe.edu.tr (M. Elcin), sturan@hacettepe.edu.tr (S. Turan), berbil@hacettepe.edu.tr (B. Erbil), zlfkrdnz@yahoo.com (K.Z. Deniz).

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generally the first responders and have very critical role while waiting for the advanced cardiac life support team (Heng et al., 2011). While CPR guidelines are altered, the roles of the multidisciplinary team members also changed and nurses' responsibilities increased and that made them a more active member of the multidisciplinary resuscitation team (Terzi, 2008). Studies confirmed that emergency cases requiring CPR can be most effectively resolved using a team-based approach (Hunziker et al., 2009, 2010a,b). Individual and team-related factors, including leadership, communication, interaction, and team structure have an impact on CPR quality (Yeung et al., 2012) and should be included in nurse and all other health professionals training.

The ILCOR describes the issues related to CPR and emergency cardiovascular care (ECC) education and divides these issues into 4 major categories: willingness to perform CPR, educational design, improving resuscitation quality, and issues related to implementation and outcomes (Mancini et al., 2010). Research on educational efforts revealed that the utilization of simulation techniques results in the mastery of CPR-associated skills and high quality of CPR execution (AHA, 2000). Several recommendations have been made regarding minimum training standards and training packages critical for implementing comprehensive CPR education (Perkins et al., 1999). Another point of emphasis was that these training events should be based on validated educational principles (Durak et al., 2006). Even though CPR programs incorporate common primary features, they differ in their professional requirements and content (examples include AHA, European Resuscitation Council - ERC, and ILCOR training). This variation has a decisive impact on each course's time, design, delivery, simulation modality, and types of evaluation.

Simulation-based educational interventions pertaining to resuscitation provide a controlled, safe learning environment (Cooper and Taqueti, 2008). Coping with high-risk medical situations (Grzeskowiak et al., 2011), simulations allow for training on and assessment of sophisticated skills in an authentic ambiance without endangering patients (Akhu-Zaheya et al., 2012). Simulation training also provides practitioners with experience in addressing rare events, significant situations, and events or situations that require rapid response and vigilance (Gaba, 2004). Simulation technologies also offer tools and techniques for multiple data recordings that provide the opportunity for the detailed analysis of teamwork behaviors (Patel et al., 2009) and for the multidimensional evaluation of the effectiveness of these interventions (Cook et al., 2013).

The main issue for healthcare systems is to maintain teams demonstrating interprofessional competencies in the workplace (Barr, 1998; Thistlethwaite, 2012). An interprofessional team can composed of two or more professionals or disciplines included, physicians, nurses and paramedics etc. A curriculum focused on this issue needs to be improved to include facilities where the students from different health professions meet each other, and learn how to work together (Patel et al., 2009).

1.2. Rationale

The ILCOR strongly emphasizes the importance of CPR training and providers responsible for healthcare delivery take ILCOR's evidence-based CPR recommendations into account. CPR training at the postgraduate level mostly addresses certification and international initiatives that have strong jurisdiction. However, the methodological and theoretical bases of CPR educational interventions at the undergraduate level are currently unclear and controversial, especially on the integration of team-based learning. Therefore, there is a need for a review on simulation-enhanced, team-based CPR training at the undergraduate level.

1.3. Objective

The main goal was to review and synthesize published evidence relevant to educational science that addresses the question "What are the features and effectiveness of educational interventions related to simulation-enhanced, team-based cardiopulmonary resuscitation training?"

2. Method

We conducted a systematic review of the medical literature to identify publications on the use of simulation-enhanced techniques for team-based resuscitation training, with a focus on their current and potential applications in cardiac arrest and emergency situations. The review protocol was developed in accordance with PRISMA statements and was registered in PROSPERO (Onan et al., 2013). Best Evidence Medical and Health Professional Education review procedures (Hammick et al., 2010) were followed by the reviewers as the main issue addressed medical practice and medical education. A modified Kirkpatrick model and its adaptation (Hammick et al., 2010) were used for collecting, interpreting, and reporting intervention outcomes.

2.1. Search strategy

The literature search that was performed covered 5 databases (PUBMED, EBSCOHOST, COCHRANE, WILEY, AND SCIENCEDIRECT). Google Scholar searches were also performed. The databases were searched using the following terms and variations: "simulation" AND (student OR undergraduate) AND (resuscitation OR CPR OR "life support") AND (team OR crew OR group) with no restriction in period of publication. The searches were conducted in September 2013. The search results consisted of a pool of articles derived from COCHRANE (33), EBSCOHOST (50), SCIENCEDIRECT (41), PUBMED (90), WILEY (21), and Gray (internet search, 9). A total of 219 articles remained after eliminating duplicates (see Fig. 1).

2.2. Article selection

2.2.1. Inclusion and exclusion criteria

Protocol-based screening criteria were obtained from the initial pool of journal articles and were used by 2 independent review coders. The required criteria for the study are as follows: the involvement of undergraduate healthcare students (people), the implementation of simulation technology, an educational activity relevant to team-based CPR (exposure or issue), and information about educational intervention and outcomes (outcome). Initial requirements were performed through article abstract reviews. There were 89 articles that did not the meet the inclusion criteria and were eliminated (animal studies, fire fighter studies, review articles, etc.). During the full text review of the remaining 130 articles, 46 articles were eliminated as they were not meeting the inclusion criteria (postgraduate, absence of team building). The remaining 84 articles were evaluated by the coders using the quality assessment checklist, and 54 articles did not meet the full quality improvement criteria.

2.2.2. Final article pool

When the Kirkpatrick classification was applied to these articles, we recognized that some articles had been reported as the part of a larger simulation study. There were 2 groups of studies at risk for bias: the studies by Kardong-Edgren et al. (2009; Kardong-Edgren and Adamson, 2009) and those by Husebø et al. (2011; 2012a; 2012b; 2013). Kardong-Edgren et al. (2009) mentioned in their article that their data were collected as an aspect of a larger