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The Effect of High Fidelity Simulators on Knowledge Retention and Skill Self Efficacy in Pediatric Advanced Life Support Courses in a Rural State☆

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ABSTRACT

Purpose: Rural health care providers (HCPs) care for millions of Americans despite challenges. Pediatric Advanced Life Support (PALS) provides rural HCPs training in assessment and interventions for critically ill/injured pediatric patients (American Heart Association, 2015). The purpose of this study was to determine the effects of integration of high fidelity simulators into PALS courses in a rural setting.

Design and Methods: Participants were randomized by course to control or experimental PALS conditions where the control group received PALS with low fidelity static manikins (LFM) and the experimental group received PALS with high-fidelity simulators (HFS). Multiple level modeling (MLM) was used to examine participants time-to-task on pre-identified skills on PALS core case scenarios during testing on the last day of the course. MLM also was used to examine the differences in PALS knowledge and skills self-efficacy (SEI) between control and experimental groups at course end and six months later.

Results: The experimental and control groups had similar scores on the PALS post course knowledge exam, however the skill performance of the experimental group on time-to-task in core case scenarios was significantly better when compared to the control group ($p = 0.05$). A decrease in knowledge exam scores and SEI scores occurred in both groups over time, however the control group had significantly greater declines in PALS written exam ($p = 0.042$) and SEI ($p = 0.003$).

Conclusions and Practice Implications: Integration of HFS into PALS may increase HCPs' ability to recall valuable knowledge when seconds matter most. Further research in long-term recall of knowledge and retention of skills following PALS training is needed.

Introduction

Healthcare providers (HCPs) who work in rural and frontier areas are the first line health care for approximately 50 million Americans living in rural/frontier designated areas of the United States (US) (US Census Bureau, 2004). Rural is defined as fewer than 1000 people per square mile, and frontier as six to eight people per square mile (Office of Rural Health Policy, 2010). According to the National Rural Health Association (2008), rural and frontier areas share some common characteristics including comparatively few people living in the area, limited access to large cities, considerable traveling distance to market areas, and an overall lack of HCPs. Children living in rural areas have increased risk of disability and death from injury, trauma, and medical diseases largely related to the aforementioned barriers and a lack of access to specialists trained in pediatrics (American Academy of Pediatrics, 2012).

Early recognition of life threating events in pediatric patients and rapid action means the difference between life, death, or permanent disability. In specialty certification courses like the American Heart Association's (AHA) Pediatric Advanced Life Support (PALS), HCPs are trained in assessment and interventions specific to critically ill or injured children. For rural HCPs, renewing PALS certification every two years may be difficult due to a variety of limitations. Furthermore, the number of pediatric patients rural HCPs care for in their practices is often limited. Because of this limited exposure to pediatric patients, rural HCPs do not have the opportunity to use the knowledge and practice skills they have learned in PALS. Hence, they may lose valuable knowledge and skills over time due to a lack of usage. When faced with a life threatening pediatric emergency and the need to rapidly access knowledge and skills, rural HCPs may not be able to recall and apply what they have previously learned. The result is that precious minutes may be lost in the rush to save a child's life.

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Research on HCPs that have taken advanced life support courses like PALS has shown that the knowledge learned in these valuable courses begins to degrade the moment the HCP walks out of the advanced life support course. By six months post course, knowledge has waned to pre-course levels (Curry & Gass, 1987; Kaye & Mancini, 1986; Mancini & Kaye, 1985; Moule & Knight, 1997). This becomes a critical clinical reality when HCPs educated in advanced life support encounter a child in need of life saving interventions, especially if it has been more than six months since the healthcare provider took the PALS course.

The use of high fidelity simulators (HFS) in health care education has gained momentum over the past ten years. Most literature pertaining to HFS in healthcare has focused on participant satisfaction with the simulation technology (Bond, Kostenbader, & McCarthy, 2001; Donoghue et al., 2009; Ebbert & Connors, 2004; Fountain & Alfred, 2009). Very few researchers have examined the long-term effects of HFS training on HCPs' knowledge retention and/or skill acquisition especially in advanced life support courses (Everett-Thomas et al., 2016; Settles, Jeffries, Smith, & Meyers, 2011). Further, most studies on HFS in healthcare education were completed in academic medical centers, not in rural community settings. The purpose of this study was to determine the effects of integration of HFS into a PALS course, specifically the effects on outcomes during the immediate post-training and six months post-training periods.

Methods

Design and Setting

In this non-equivalent control group posttest trial of the incorporation of HFS into PALS courses, HCPs taking a two-day PALS course in eastern Montana were invited to participate in the study. Eastern Montana encompasses land located east of the Continental Divide and includes 32 of Montana's 56 counties. All but eight Eastern Montana counties are considered rural and more than 10 are considered frontier. Human subjects approval was obtained from University of Colorado Denver Multi-Institutional Review Board and the Billings Area Institutional Review Board. Written informed consent was obtained at the beginning of each course.

Sample

Eligible participants were defined by AHA PALS course guidelines as being registered nurses, licensed practical nurses, nurse practitioners, physician assistants, medical doctors, doctors of osteopathy, emergency medical technicians, or paramedics. Further eligibility criteria specified that participants be HCPs practicing in eastern Montana and willing to participate in follow up testing via the internet six months after completing the PALS course.

Procedure

Courses scheduled during the study period were randomly assigned to PALS courses with HFS (experimental) or courses with low fidelity manikins (LFM) (control). Clustering of the experimental and control groups based on class enrollment provided a practical and cost-effective way to randomize the participants. A total of six courses were assigned to experimental clusters and five courses were assigned to control clusters.

Control and experimental groups completed a two-day PALS course as specified by AHA standards. The only difference between the courses was the experimental/HFS courses used a high-fidelity simulator manikin (SimBaby Laerdal Corporation) for all hands-on portions of the PALS training. SimBaby is a highly realistic patient simulator capable of many life like features including but not limited to respirations, retractions, abnormal heart sounds and breathe sounds, and with limbs that allow for placement of intravenous and intraosseous lines. The control courses used a low-fidelity static manikin (Baby Anne and Little Junior Laerdal Corporation). Baby Anne and Little Junior are low cost resuscitation manikins with realistic features such as an articulating jaw, chest compliance for compressions and ventilations as well as realistic chest rise and fall. Both manikins rely on instructors to provide course participants with information such as vital signs, assessment findings, and response to treatments provided. Data collected at the end of the two-day PALS course included demographic data, PALS written knowledge exam scores, PALS Self-Efficacy Inventory (SEI) scores, and Core Case Scenario time-to-task scores. The PALS course demographic data, PALS written knowledge exam scores, and PALS Self Efficacy Inventory were all administered via paper and pencil. Data were then entered by the primary investigator into a password protected excel database then imported into SPSS.

At the six months follow up, PALS written knowledge exam scores and PALS SEI scores were collected and managed using REDCap (Research Electronic Data Capture) electronic data capture tools hosted at University of Colorado Denver (Harris, Taylor, Payne, Gonzalez, & Conde, 2009). REDCap is a secure, web-based application designed to support data capture for research studies, providing: 1) an intuitive interface for validated data entry; 2) audit trails for tracking data manipulation and export procedures; 3) automated export procedures for seamless data downloads to common statistical packages; and 4) procedures for improving data from external sources. Data from the REDCap database were exported to an excel file and then imported into SPSS.

Measures

PALS Written Exam

Three instruments were used to collect data from both the experimental and control courses. Pediatric Advanced Life Support knowledge was assessed with the PALS written exam prepared by the AHA at the end of the course and six-months post course. The PALS written exam consists of 33 multiple-choice items. All participants in the study were given Version B of the written exam at the end of the two-day course. Only the first attempt score was recorded. Version A of the written exam was administered six months later via electronic, web-based format.

PALS Self-efficacy Inventory

The PALS Self-Efficacy Inventory (SEI) was developed for this study. The inventory consisted of 19 PALS skills or tasks on which participants rated their confidence level on performing each skill/task using a Likert scale ranging from 1, not at all confident, to 10, completely confident. The inventory was developed using the PALS Psychomotor Course Objectives as identified in the PALS Course Provider Manual and reflected content validity as determined by the PALS curriculum authors as a way to measure outcomes of PALS training. Examples of some of items on the PALS SEI included: calculate the correct dosage of medication for a pediatric patient, recognize pediatric shock, and use effective communication with team members throughout a resuscitation. Item scores were summed and averaged to produce a total PALS SEI score with a possible range of 0 to 10. A higher score indicated the participant was more confident performing PALS skills. Using the Statistical Package for Social Sciences (SPSS) Version 24, a Cronbach's alpha coefficient of 0.879 was calculated for the PALS SEI from the study data at the end of training and a second Cronbach's alpha coefficient of 0.932 was calculated on data from the six-month post course testing. PALS SEI scores were collected for all participants at the end of the course and at six-months post course.

Scenario Based Skills Time-to-task

Pediatric Advanced Life Support skill was assessed by instructor recorded time-to-task on specific skills during performance testing on the core case scenarios. The PALS core case scenario checklist was designed by the AHA to evaluate individual participant performance on