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Performance comparison in Pediatric Fundamental Critical Care Support among staff from the USA versus those from resource-limited countries

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Abstract

Objective: This study aimed to evaluate the performance of participants in the USA compared with international participants taking the Pediatric Fundamental Critical Care Support (PFCCS) course, and the significance of training for resource-limited environments.

Methods: PFCCS courses were conducted in the USA, El Salvador, Haiti, Kenya, and Nepal between January 2011 and July 2013. All of the participants took pre- and post-tests. We compared the performance of these tests between international and USA participants. All participants answered a post-course survey to evaluate the didactic lectures and skill stations.

Results: A total of 244 participants took the PFCCS course, comprising 71 from the USA, 68 from Kenya, 37 from Haiti, 48 from Nepal, and 20 from El Salvador. The mean pre-test score of USA participants (50.6%) was significantly higher than that of international participants (44.7%). There was no significant difference in the post-test score between USA and international participants (78.6% versus 81.4%). There was a significant difference between pre- and post-test scores. There was better appreciation of the course content by the USA participants.

Conclusion: International course takers without prior pediatric intensive care training have similar test scores to USA participants suggesting comparable efficacy.

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Introduction

Pediatric Fundamental Critical Care Support (PFCCS) is a 2-day course that was developed by the Society of Critical Care Medicine (SCCM) to meet the needs of pediatric critical care children in the absence of a pediatric intensivist. This training prepares healthcare personnel with limited pediatric critical care experience with the fundamentals to stabilize critically ill children during the first 24 to 48 hours.[1,2] PFCCS was inspired by the Fundamental Critical Care Support course, which has provided training for adult critical care globally since the mid-1990s.

Unlike Pediatric Advanced Life Support (PALS), the PFCCS course attempts to address acute management, resuscitation, stabilization, and ongoing care of critically ill pediatric patients. PALS is supported by the American Heart Association. PALS is a course that is mainly designed to address acute resuscitation of pediatric patients for healthcare providers.[3] The SCCM released the first edition of the PFCCS course textbook in May 2008. The PFCCS course rapidly gained acceptance as a standardized method of disseminating the fundamental concept of pediatric critical care services. This course was designed for healthcare providers who are involved in initial management and/or transfer of critically ill or injured infants and children in the USA, in developing countries, and in resource-limited areas.[4]

In September 2010, a group of pediatric intensivists and nurses, committed to the development of pediatric critical care services set out to teach this course in 4 resource-limited countries where there was no formal pediatric critical care training for health care providers, through a non-profit organization Pediatric Universal Life-Saving Effort (PULSE). Since then, PULSE focuses on building a global health network, as well as improving healthcare delivery to critically ill patients in countries with limited resources. PULSE's global health teams are led by doctors who have an intimate knowledge of the local infrastructure and medical education system. The team members include PFCCS consultants and instructors and volunteers from the USA with a commitment to development of pediatric critical care service in their native countries. We conducted the first PFCCS course on the African continent in Nairobi, Kenya in March 2011. This course served to train medical personnel who currently work within acute care areas within pediatric wards, accident and emergency, pediatric intensive care units as well as general intensive care units within Kenya, where critically ill pediatric patients are admitted. Subsequently, PULSE volunteers conducted several courses in Nepal, Haiti and El Salvador.

This study aimed to investigate the relevance and efficacy of the PFCCS course in resource limited countries in augmenting pediatric critical care services. We compared the performance of international participants with those from the USA to determine if the PFCCS course needs to be modified for limited-resource environments.

Materials and methods

Intervention

The PFCCS course is a 2-day educational program with didactic lectures and skill stations. The educational material for each day encompasses an 8-hour session that balances a nearly equivalent amount of time spent between didactic lectures and practical sessions.[2] The didactic lectures include core topics in pediatric critical care, such as acute respiratory failure, mechanical ventilation, shock, acute infection, fluid and electrolyte management, neurologic emergencies, trauma and transport of the critically ill child. This course also includes skill stations in airway evaluation and management, mechanical ventilation, sedation, trauma, transport, invasive devices and their potential complications. A standard textbook published by the SCCM is also part of the educational material. The target audience of PFCCS includes hospitalists, advanced practice nurses, physician assistants, rapid response teams, critical care fellows, nursing staff, and other pre-hospital providers involved in the care of unstable, critically ill, or injured pediatric patients. The course content is divided into chapters that reflect current guidelines and practices regarding fundamental aspects of pediatric critical care. There is an emphasis on preparing participants for management of acutely deteriorating pediatric patients, within the first 24 hours post-resuscitation until appropriate transfer or consultation with a pediatric intensivist can be arranged. The PFCCS course is designed to promote teamwork while teaching the fundamentals of critical care and does not intend to substitute the pediatric intensivist. A prerequisite for the course candidate includes certification in basic life support and PALS.[5–7] The skill stations are designed to allow the candidates to perform as equal members, while performing different roles, including team leadership.

In 2009, the pediatric intensive care unit (PICU) staff in our institution decided to improve the competency of PICU nurses, hospitalists, emergency physicians, and pediatric residents. We identified the PFCCS as a strategic tool for implementing this project. The New York Pediatric Disaster Coalition to which our hospital belongs also recommends the PFCCS as a training tool for non-critical care medical staff.[8,9] The courses were taught by strict adherence to the protocol and standard specified by the SCCM.

Subsequently, the same group of pediatric intensivists conducted the global health project to develop pediatric intensive care in resource-limited settings. PULSE began this project in Haiti, Kenya, Nepal and El Salvador with the goal of stimulating starting points for creating pediatric intensive care hubs and training centers. From March 2011 to August 2013 five PFCCS courses were conducted at The Brooklyn Hospital Center. The attendees of this course in the USA included pediatric nurses, nurse practitioners, pediatric residents, and pediatric hospitalists from the PICUs and pediatric emergency departments of community hospitals. We recruited candidates for the USA courses by direct promotion via our hospital website. Additionally, the SCCM website published the course dates on the approved PFCCS website. These courses included attendees from seven different USA hospitals with level II PICUs in accordance with the following guidelines.[10] In 1993, the Pediatric Section of the Society of Critical Care Medicine and the Section on Critical Care Medicine and Committee on Hospital Care of the American Academy of Pediatrics issued guidelines for the level of care in PICUs in the United States. The guidelines state that "pediatric critical care is ideally provided by a PICU that meets

level I specifications".[10] Level I PICUs have the resources to care for a wide range of complex medical and surgical critical illnesses for pediatric patients of all ages, including newborns and premature infants. Level II PICUs have fewer resources with less availability of pediatric intensivists and other subspecialty services compared with level I PICUs.

Study design

A retrospective analysis of several courses that were conducted internationally and in the USA was performed. We compared test performances for theoretical knowledge and post-course evaluation by the participants for a descriptive analysis of the course delivery. Eight courses were conducted internationally at institutions without PICUs, comprising three in Kenya, two in Haiti, two in Nepal, and one in El Salvador. None of the course participants had formal pediatric critical care training. The goal of providing these courses in countries with limited resources was to bolster critical care services, improve healthcare delivery, and lessen the healthcare disparity that exists in resource-limited areas. The international participants consisted of pediatric and adult nurses, advanced practice nurses, attending physicians, hospitalists, and pediatric residents. None of these participants had prior exposure to pediatric critical care.

The participants for the international courses were selected to participate in the course based on the staffing needs of the hospitals that were interested in developing PICU hubs in association with PULSE. These participants included staff physicians who were likely to care for patients in the emergency room and pediatric special care units.

Certified PFCCS instructors who were led by a course director in conjunction with a course consultant conducted the courses after obtaining a license from SCCM. The course consultants were the same for all of the courses. The directors were also present during all of the courses, and rotated as directors and instructors as part of the same team. The course consultants and directors had extensive experience and maintained their status by SCCM standards by teaching at least two courses per year. The training program strictly adhered to the standards set by the SCCM without any deviation. The participants received PFCCS textbooks several weeks before the course date with emphasis on a list of core chapters. At the beginning of the 2-day course, each participant The international participants consisted of nurses, general practitioners and hospitalists, pediatric residents, pediatricians and various pediatric sub-specialists. None of these providers had prior exposure to formal pediatric critical care training. took a pre-test to assess their baseline theoretical knowledge in pediatric critical care. Each course had an average of 24 participants. We divided the participants into groups of six to eight with an assigned certified instructor to conduct the skill stations. Each skill station had standardized case scenarios that required a goal-directed approach to the patient's management based on the acronym of DIRECT (Detection, Intervention, Reassessment, Communication, and Teamwork). As part of the course requirement, the course director reviewed the 10 pre-test questions with the participants during the wrap-up session. At completion of the course, we administered 50 multiple choice post-test questions to the candidates. The passing grade required a minimum score of 35 (70%) correct answers. The test questions and the passing score were established by a group of pediatric critical care experts who were part of a committee as an editing task force for the PFCCS textbook. The questions were frequently reviewed to ensure a level of fundamental pediatric critical care knowledge. The task

force stipulated that a raw score of 35 out of 50 (70%) questions was sufficient to establish proficiency of the participants after the 2-day course. The participants completed a standardized anonymous course evaluation survey provided by the SCCM. The survey included demographic information and questions answered on a 5-point Likert scale that qualified the applicability, satisfaction, and relevance of the course. The Institutional Review Board of The Brooklyn Hospital Center reviewed the questionnaire for any risk to subjects and approved the study. The Institutional Review Board of The Brooklyn Hospital Center waived the need for informed consent of the subjects because of the retrospective study design and use of an anonymous survey.

Analysis

We retrospectively reviewed the post-test score, demographics, and survey results for the USA and international participants. Values are shown as mean ± standard deviation or numbers and percentages. We indexed the data on a spreadsheet and analyzed the performance of the two groups using the two-tailed unpaired *t*-test with JMP software (SAS Institute, Cary, NC, USA).

Results

The distribution of participants by country was 71 (29%) in the USA, 68 (28%) in Kenya, 37 (15%) in Haiti, 48 (20%) in Nepal, and 20 (8%) in El Salvador (Figure 1). The theoretical knowledge as a result of pre-test scores was higher in USA participants than in international participants ($p = 0.039$). However, the post-test scores were similar between USA and international participants. We trained a total of 244 healthcare professionals. Of these, 123 (50%) were practicing physicians, 55 (23%) were nurses, 44 (18%) were physicians in

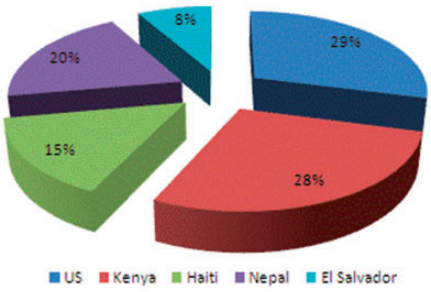

Figure 1. Distribution of course participants.

training, and 22 (9%) were other allied professionals (Figure 2). Of the 173 international participants, 64% were physicians, 18% were pediatric residents, 10% were nurses, and 8% were allied healthcare professionals. A total of 144 (66%) of the participants had 1 to 5 years of clinical experience, 14 (8%) had 5 to 10 years of practice, 37 (21%) had greater than 10 years of practice, and eight (5%) did not report their years of experience. A total of 50% of participants worked in a university hospital setting, 31% worked in a community hospital, and 19% worked in non-hospital settings. Of the 71 USA participants, 51% were nurses, 13% were nurse practitioners, 17% were pediatric residents, and 17% were practicing physicians. A total of 33 (46%) of participants had 1 to 5 years of clinical experience, nine (13%) had 5 to 10 years of practice, 27 (38%) had greater than 10 years of practice, and four (6%) did not report their years of experience. A total of 55% of participants worked in a community hospital affiliated with a university center.

Analysis of the pre-test showed a significantly higher mean score for USA participants (50.6% ± 22.05%) compared with international participants (44.7% ± 20.5%, $p < 0.05$). The USA median test score was 50% and the international median score was 40%. The overall mean score of the post-test for all candidates was 80.8% ± 9.5%. There

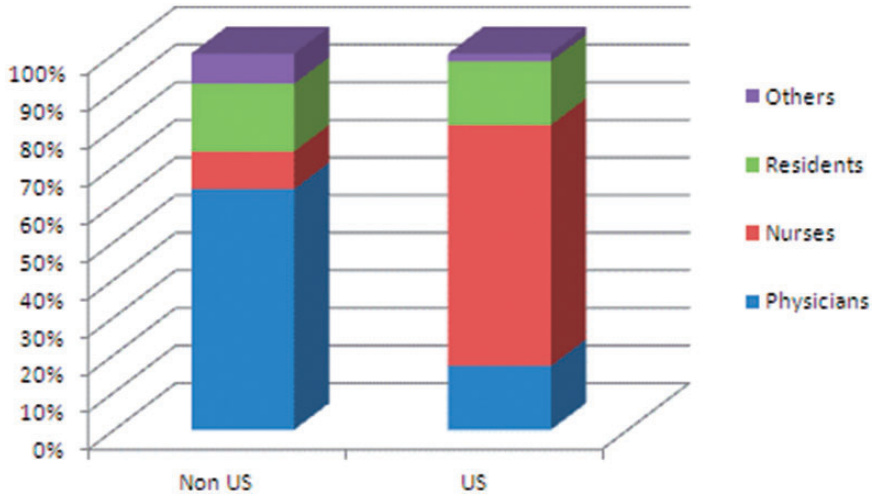

Figure 2. Distribution of participants by profession.

Table 1. Comparison of lecture evaluations.

Lectures	USA score	International score	p value
Respiratory failure	4.80 ± 0.58	4.46 ± 0.44	<0.0001
Pediatric shock	4.77 ± 0.45	4.56 ± 0.53	<0.0001
Neurological emergencies	4.68 ± 0.61	4.37 ± 0.63	<0.0003
Trauma	4.67 ± 0.65	4.24 ± 0.77	<0.0001
Fluids and electrolytes	4.70 ± 0.58	4.29 ± 0.70	<0.0001
Transport	4.70 ± 0.58	4.29 ± 0.70	<0.0001
Postoperative care	4.71 ± 0.53	4.21 ± 0.66	<0.0001
Sedation	4.68 ± 0.58	4.39 ± 0.62	<0.0003

Values are mean ± standard deviation

was no significant difference in the mean post-test score of USA and international participants (78.6% versus 81.4%). The post-test score for each of the groups showed a significant improvement in score compared with the pre-test score (paired t-test, both $p < 0.001$ for international and USA).

The post-course survey showed a high appreciation for the course content by the USA and international participants. The responses of the participants showed a significant difference between the two groups for assessment of clinical application of the course (USA, 4.64 ± 0.70 versus international, 4.36 ± 0.67, $p = 0.002$). Other questions that evaluated satisfaction of the lectures and skill stations showed a significantly greater appreciation of the course by USA participants than by international participants (all $p < 0.001$, Tables 1 and 2).

Discussion

The PFCCS course serves to increase the theoretical knowledge of pediatric and non-pediatric practitioners in the USA

Table 2. Comparison of skill station evaluations.

Skill stations	USA score	International score	p value
Airway management	4.73 ± 0.84	4.34 ± 0.55	<0.0001
Pediatric shock	4.73 ± 0.48	4.23 ± 0.68	<0.0001
Mechanical ventilation I	4.71 ± 0.65	4.37 ± 0.52	<0.0001
Mechanical ventilation II	4.76 ± 0.45	4.40 ± 0.63	<0.0001
Trauma	4.64 ± 0.59	4.35 ± 0.62	<0.0005

Values are mean $\pm$ standard deviation

caring for critically ill pediatric patients. This applies to the intensive care setting, emergency room, transport, lower level PICUs for the first 24 hours until appropriate transfer or advanced level of care is available. However, this course may not be as applicable in resource-limited countries where pediatric critical care infrastructure has not yet been established. Atagi et al.[11] suggested that the FCCS and PFCCS could be used in areas where there is no standardized training system for critical care in Japan. Turner et al.[12] made similar observations in sub-Saharan Africa.

To date, few published data have addressed the relevancy of the PFCCS course in improving staff preparedness to care for critically ill pediatric patients. Werner and Bruzzini concluded that the PFCCS course is efficacious in improving the perception of pediatric residents and nurse practitioners in recognition and management of critically ill children.[13] A total of 50% of the participants in our survey were in training with limited or no exposure to formal pediatric critical care. Therefore, whether self-efficacy equates to actual readiness to care for sick pediatric patients is unknown.[14] There is evidence that similar courses implemented in Zambia and Kenya increased knowledge, confidence, and added new skills relevant to these resource-limited areas.[15,16] Rodenbarger et al.[17] reported that PFCCS courses improved self-efficacy, preparedness, and the skills of pediatric physicians in training.

PFCCS courses that were conducted nationally and internationally used consultants, directors, and instructors with minimal variability in team composition. We compared the performances of pediatric healthcare practitioners from the USA who worked in level II PICUs with those from resource-limited countries with limited or no exposure to pediatric critical care. Both groups had similar scores on the post-test. This finding suggests that the knowledge in core critical care concepts can be assimilated by healthcare providers who have little or no exposure to critical care because it is practiced in industrialized countries. While this is indicative of new skills and knowledge, successful completion of a PFCCS course may be a surrogate for improving outcomes.

In our study, post-course evaluation of the lectures showed that there was a small, but significant, difference in satisfaction between USA and international participants. A factor that can explain this finding is the difference in demographic composition of the participants. The USA participants mostly comprised nurses and nurse practitioners who worked in medium-sized PICUs that were staffed with pediatric intensivists. In contrast, most of the international participants were physicians. The international participants had a lower appreciation score for all of the skill stations and lectures. An explanation for this observation might be related to the lack of familiarity with the equipment displayed at

the skill stations. Furthermore, equipment for central venous line placement and mechanical ventilation are not readily available in most of the areas where international participants practice.[18] Finally, the lack of a standardized protocol for management of trauma in these countries may account for these observations.[19] Because of the limited resources and the difficulty in transporting high-fidelity simulators, we only conducted the skill stations for international participants using a low-fidelity simulation model. Considering these factors, the perception of the value and relevance of the skill stations reported by the international candidates may have been affected.[20]

The content of the didactic and skill stations of the PFCCS course were primarily designed for healthcare providers in industrialized nations where resources and technology may be readily available. Historically, the FCCS and PFCCS courses were designed for resource-rich countries, and their application was not meant to replace the role of the intensivist in managing critically ill patients.[21] In contrast, there is a higher burden of disease in resource-poor settings. The potential for incremental benefit may be higher in the goal to decrease morbidity and mortality in resource-limited environments.[22] In our study, on the basis of feedback received from the first course, we incorporated the application of bubble continuous positive airway pressure as part of the ventilator skill station in Haiti as the most available and low-cost form of respiratory support for newborns and small infants in that country.[23,24] We hope to acquire more understanding on the role of pediatric critical care in resource-limited environments. However, success of any training program may be dependent on many factors, including the cost, resource allocation, healthcare workforce and education, task-shifting,[12,18] and the combination with local clinical practices.

There are limitations to the results of our study. The two studied groups were heterogenous because the international participants were mostly physicians, whereas the USA participants had more allied healthcare professionals. Additionally, the performance in theoretical knowledge of participants pre- and post-course could not be determined because the pre-test was a limited version of the post-test. Finally, the international group was not exposed to the high-fidelity simulation experience. However, a formal testing of the skill stations was not part of the course standard, except for the post-course survey evaluation returned by the participants.

The PFCCS course served as an introduction to the concepts and practice of pediatric critical care, especially for international participants. According to our anecdotal experience and the observations of Ralston et al.,[25] the providers whom we trained are currently assuming the role of a pediatric intensivist. Furthermore, implementation of this course on a regular basis was a catalyst for local development of critical care services and implementation of critical care training programs by others.[22,26] Future assessment studies in implementation may show changes in the infrastructure for resource-limited areas. We hope to add hi-fidelity simulation to our training and evaluation process in the near future to enhance the course, as well as clinical outcomes.[27]

Conclusions

The theoretical performance of international participants in the PFCCS course is comparable to that of participants from the USA. There is a greater appreciation of the skill stations and didactic lectures by USA participants than by international participants. Further study is warranted to determine the true effect of cultural differences in survey responses. We speculate that

introduction of high-fidelity simulation integrated with the scenarios during our skill stations during the course may enhance the psychomotor abilities of physicians and other practitioners.[27–31]

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Declaration of conflicting interest

The authors declare that there is no conflict of interest.

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