FIELD NOTES

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Pediatric Resuscitation Education in the Age of COVID-19: A pilot study of pediatric advanced life support training in low-middle income countries via videoconferencing

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ABSTRACT Despite improving medical care worldwide, vast healthcare disparities remain in low- and middle-income countries (LMIC). In Haiti, the under-5 mortality rate is more than double the rate of the neighboring Dominican Republic. Through a partnership with St. Damien and Hospital Bernard Mevs in Port-Au-Prince, Haiti, and the Department of Emergency Medicine, University of Minnesota Medical School, healthcare providers have collaborated to improve pediatric emergency care and outcomes by teaching American Heart Association (AHA) courses in Haiti. Due to the COVID-19 pandemic, many global health initiatives, including through the University of Minnesota, have been postponed indefinitely. In efforts to continue working toward improved delivery of care, we sought to pilot a, AHA Pediatric Advanced Life Support (PALS) course in Haiti. We delivered a complete AHA PALS course through videoconferencing, with participants engaging in hands-on procedures and simulations. We surveyed participants' confidence in relevant skills and knowledge pre- and post-course. Results showed significantly improved ratings in 12 of the 18 surveyed items ($p<0.05$). Participant satisfaction with the videoconferencing delivery of the course indicated that videoconferencing may be an effective method of course delivery. Videoconferencing shows promise as a successful tool to continue global health education.

KEYWORDS Haiti, Pediatric Health, Medical Education, Critical Care

INTRODUCTION

Since 1990, the global under-5 mortality rate has dropped by nearly 60%. Still, there remain astonishing disparities between low- and middle-income countries (LMIC) and high-income countries (HIC)[1]. In Haiti, the under-five mortality rate is a staggering 64.8 per 1,000 live births, over double the rate of the Dominican Republic and over nine times that of the United States of America[2]. At Hôpital Saint Damien-Nos Petits Frères et Soeurs (St. Damien), the only free-standing pediatric hospital in Port-Au-Prince, Haiti, over half of newborn intensive care unit (NICU) admissions and 22% of neonatal deaths are attributed to infection and sepsis[3].

National guidelines for resuscitation of pediatric patients are laid out by the American Heart Association (AHA). The AHA Pediatric Advanced Life Support (PALS) course guides healthcare providers through videos and hands-on simulations designed to lay a framework in pediatric assessment and treatment[4]. Specifically, it

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emphasizes appropriate recognition and management of shock, respiratory distress/failure, and cardiac arrhythmias. When implemented, AHA PALS course guides has been shown to decrease pediatric mortality by almost half when implemented[5, 6, 7].

In efforts to improve delivery of pediatric acute care, faculty from the Department of Emergency Medicine, University of Minnesota Medical School, an AHA Training Center (ITC), have collaborated with St. Damien Hospital and Hospital Bernard Mevs, in Port-Au-Prince, Haiti. Over the last three years, efforts have centralized around PALS provider and instructor courses for advanced healthcare practitioners and Pediatric Emergency Advanced Assessment, Recognition, and Stabilization (PEARS) courses for nurses and Emergency Medical Technicians. All courses were led by instructors based at the University of Minnesota at the request of the AHA. An in-person PALS course was scheduled for March of 2020 but was postponed due to the COVID-19 pandemic. Like most global health institutions, the University of Minnesota Medical School paused global health programs, especially in medical education. Unable to travel, the program sought an alternative means to conduct medical education with its Haitian partners.

Videoconferencing has played a valuable role in global health work and is cited as a component in many courses[8, 9]. Previous pilots showed videoconferencing as a successful tool for aspects of medical education courses in low and middle-income countries (LMIC) including patient simulation and ultrasound training, with equivalently accurate evaluation of hands-on testing compared to in-person scoring[10, 11]. In 2008, a domestic U.S.-based study found similar outcomes of conducting a PALS course in-person and via videoconferencing, indicating the effectiveness of virtual learning with a PALS course[12]. To our knowledge, there are no documented efforts to conduct a complete AHA course over videoconference in LMIC. This pilot study sought to determine the effectiveness of teaching an AHA PALS course over videoconferencing in LMIC.

METHODS

PALS Course

PALS is designed with multiple learning modalities, aiming to improve outcomes of critically ill pediatric patients. Interactive videos of real patients allow for accurate visualization, with pauses within the video to discuss the situation and receive immediate feedback. Hands-on activities following each video reinforces skills and allows for additional feedback. Mastery Learning and Deliberate Practice techniques, which consist of continual simulation-based learning with immediate feedback, helps students consistently demonstrate competent pediatric resuscitation skills. This repetitive hands-on experience has been shown to improve performance in pediatric resuscitation competence(13). Competence is assessed through both formative and summative performance, using contextualized simulations as a key component of team training.

Course Delivery

The course took place between July 6th and July 15th, 2020, comprising five half-days over the span of two weeks. Each half-day consisted of between two to three and a half hours of the course (Supplemental Table 1). Participants were selected from the emergency department and intensive care unit (ICU), which included two attending physicians, six senior resident physicians, two nurses, and a nurse manager. Selection was done by the head ICU physician and nurse manager. Participation in the course was voluntary. First- and second-year residents were excluded from the pilot course.

Prior to the course, all participants were given a PALS provider manual to review and passed the online pre-course self-assessment, as required by the AHA. Sessions were delivered with ITC instructors in their respective homes in Minneapolis, MN, and participants in St. Damien in Port-Au-Prince, Haiti. Using screen share on Zoom, ITC instructors followed the PALS video to facilitate topic-relevant discussions. Two interpreters, a multilingual (English, French, and Creole) physician and a nurse manager in Haiti acted as interpreters between the ITC instructors and participants.

During the hands-on skills sessions, ITC instructors teamed with a Haiti-based PALS-certified physician or a PALS provider experienced nurse that was in-person at St. Damien for demonstration of proper technique and to provide additional feedback. ITC instructors observed the skills and scenarios through a video camera focused on the simulation area.

Survey Development

Pre- and post-course surveys were developed through consensus of three U.S.-based investigators: a physician, a

a paramedic, and a basic life support (BLS) instructor. The survey was then approved by the head ICU nurse as well as a nurse manager at St. Damien. The pre-course and post-course survey consisted of eighteen questions to measure participants' self-reported confidence level in skills and knowledge related to the PALS curriculum. Survey content can be seen in Tables 1 and 2. Participant responses were based on a 5-point Likert scale with 1 reflecting "not confident", through 5 reflecting "completely confident". This measure was repeated post-course along with ratings of effectiveness related to teaching methods, as well as an open-ended feedback section for comments and suggestions. Responses related to teaching methods were based on a 5-point Likert scale with 1 reflecting "not useful", through 5 reflecting "very useful". Participants were asked to anonymously complete the pre-course survey 24 hours prior to the course and the post-course survey the day after the conclusion of the course. Additionally, time was given at the very beginning of the course to fill out the pre-course survey. Daily reminders were sent to all participants for three days post-course. The survey was delivered online and was available in both English and French.

Ethics/IRB Approval

This study was approved by the Institutional Review Boards at the University of Minnesota (STUDY00010251). Voluntary electronic consent was obtained from participants prior to participation.

RESULTS

Eight of the eleven participants completed the pre-course survey and seven completed the post-course survey. All respondents were physicians

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Pre- and Post-Course Confidence Levels

Overall, participants showed an increased level of confidence in every surveyed skill and knowledge post-PALS course. The mean of means from the post-course survey was 4.55, significantly higher than the pre-course survey, 3.62 ($p<0.001$). Due to the anonymity of the responses, an unpaired t-test was carried out, which showed a statistically significant increase in confidence level for 12 of the 18 (66.67%) items (Table 1). The largest change in confidence levels was noted with interpretation of electrocardiogram (ECG) rhythms (3.86 versus 2.00, $p=0.001$) and using a defibrillator (4.00 versus 1.43, $p<0.001$). Topics covered briefly, such as placement of intraosseous (IO) catheter and performing pediatric intubation did not show significant increase in confidence level. Full results can be seen in Table 1.

TABLE 1: Results from pre- and post-course survey. Each topic was rated on a 5-point Likert Score, with 5 being the highest possible rating. Statistically signficant values are denoted in bold and with an asterisk.
CPR = Cardiopulmonary Resuscitation, IO = Intraosseous, ECG = Electrocardiogram

Topic	Pre-Course Mean	Post-Course Mean	P-value
Knowledge of skills for pediatric patient resuscitation	3.63	4.29	**0.017**
Performing pediatric patient resuscitation	3.29	4.43	**0.0009***
Leading a pediatric resuscitation	3.43	4.43	**0.0249***
Opening a pediatric airway	3.63	4.86	**0.001***
Bag-valve-mask ventilation	4.13	5	**0.0021***
Performing pediatric intubation	3.88	4.33	0.2351
Using resuscitation medications	3.13	4	**0.019***
Using a defibrillator	1.43	4	**<0.0001***
Performing CPR	4	5	**0.0207***
Placement of IO catheter	4.38	4.57	0.559
Recognition of respiratory distress	4.38	4.71	0.3055
Treatment of respiratory distress	3.38	4.71	**0.0009***
Recognition of respiratory failure	4.25	4.57	0.3892
Treatment of respiratory failure	3.5	4.43	**0.0123***
Recognition of shock	4.13	4.86	**0.0145***
Treatment of shock	3.88	4.57	0.0652
Interpretation of ECG rhythms	2	3.86	**0.001***
Working in a team	4.14	4.71	0.0779

Teaching Method Effectiveness Rating

Participants rated nine teaching methods utilized to deliver educational material during the course. All participants reported that every teaching method was either "very useful" or "fairly useful" (Table 2). Among delivery methods used, the PALS textbook, Airway and Shock Skills Stations, and scenarios were rated as the most useful, with all participants rating 5.00 out of 5.00. All participants reported satisfaction with the videoconferencing delivery of lectures and discussions with instructors, rated at 4.57 and 4.71 out of 5.00, respectively.

TABLE 2: Results from nine teaching methods used during the course. Each topic was rated on a 5-point Likert Score, with 5 being the highest possible rating. N=7

Teaching Method	Mean
PALS textbook	5.00
Zoom Lectures	4.57
Interactive Zoom Sessions	4.71
Skills Stations	4.86
Airway skills station	5.00
CPR skills station	4.57
Cardiac skills station	4.86
Shock skills station	5.00
Scenario station	5.00

Open-Ended Participant Feedback

In the post-survey open-ended feedback section, participants expressed desire for more frequent courses, leaving no negative comments.

DISCUSSION

This pilot study was designed to determine the effectiveness of conducting hands-on medical education courses via videoconferencing in LMIC, adding to the growing body of knowledge regarding virtual learning within global health work. With the need for worldwide healthcare and education increasing, the COVID-19 pandemic has forced organizations to creatively alter normal operations. We hypothesized that an AHA PALS course over videoconferencing could successfully be conducted with minimal changes to the course and content delivery. On-site trainers and virtual instructors simultaneously assessed hands-on demonstration of learned skills.
Based on a pre- and post-course survey, participants demonstrated significantly increased level of confidence in their skills and knowledge after completion of the course, providing preliminary evidence that videoconferencing can be an effective learning modality. Skills with lower initial confidence levels, such as ECG interpretation and defibrillation, showed the largest increase in level of confidence. Other skills such as IO insertion and pediatric intubation, which were minimally discussed during the course due to time constraints, showed only slight improvement in confidence. This data suggests that content delivery was effective, and that videoconference instruction directly improved skill-based confidence.

Though more data is needed to make recommendations, this pilot study adds to the growing evidence that videoconferencing can be an effective tool for teaching complex topics, and could be routinely deployed in a global health setting(8,10–12,14). Future studies should compare changes in confidence level following in-person courses versus videoconferencing courses, as well as long-term follow-ups to track participant knowledge and skill retention. Additionally, studies should seek to translate course-based learning to improved clinical skills and critical thinking, preferably linking to patient outcomes.

Limitations

Due to the COVID-19 pandemic social distancing requirements, the sample size was small and only allowed for minimal statistical analysis. Additionally, while participants had increased confidence in skills and knowledge, no quantitative data exists that supports the learning translating to improved quality of care. Finally, despite having several nurses in the course, none of the nurses completed the survey, resulting in a homogenous sample of physicians. Therefore, it is unknown how effective this course was for nurses. This is possibly due to language barriers or a lack of accessible internet connection. We will continue to provide virtual PALS and PEARS courses and additional studies with increased sample size, using data from larger cohorts as well as increasing efforts to

ensure that nurses are able to complete the survey.

Lessons Learned

First, we believe any distance interactive training is best delivered with an onsite facilitator. Ideally, this facilitator is an AHA PALS instructor or certified provider. Experienced physicians or nurses can substitute this role, but must be well acquainted with the PALS curriculum. Second, interpreters are essential if language barriers exist. This necessitates pauses to allow interpretation resulting, in our experience, in double the instruction time of single language courses.

Third, ensuring reliable audiovisual and internet connection cannot be sufficiently emphasized. Ensuring technological compatibility and performing practice runs will streamline course delivery. Because of the difficulty we had playing the AHA videos on the hospital computers, we purchased the online version of the course and played over Zoom, minimizing technical interruptions. Training in large rooms requires external speakers and microphones to facilitate discussion and enhance engagement.

Fourth, early distribution of language-appropriate textbooks allows students to seek clarification of the curriculum before the course. Students rated the PALS book as one of the most effective delivery methods of educational resources. Unfortunately, French materials are not currently available.

Overall, participants were active and engaged in the process and showed great patience during the multiple interpretation pauses, internet interruptions, and other technological glitches.

CONCLUSION

This pilot study demonstrated preliminary evidence to support the effectiveness of videoconferencing-based hands-on medical education in LMIC. Participants communicated overall satisfaction with the course and improved confidence in skills and knowledge after the course. While traveling is not advisable and many global health programs are on hold due to the COVID-19 pandemic, in-person educational programs may be able to continue by adapting to videoconferencing as an effective format. Despite challenges, we encourage global health programs to consider videoconferencing delivery of global health education.

SUPPLEMENTAL MATERIALS

Course Schedule: Working with St. Damien, the course took place over five days (Table 3). Day 1: all participants participated in video-based didactic content with discussions throughout. Day 2: participants were divided into two groups, rotating through one hour of Pediatric Basic Life Support (BLS) and Management of Respiratory Emergencies. Day 3: the group reviewed of Cardiac Arrhythmias, followed by small group rotations through skills stations of Cardiac Emergencies and Shock Management. Day 4: participants practiced contextualized versions of the Respiratory, Shock, and Cardiac Scenarios. Day 5: participants worked through testing scenarios, each physician participant leading a respiratory or shock and cardiac testing case and nurses demonstrating initiation of code response for all testing scenarios and managing patient care until physicians arrived.

TABLE 3: Course Schedule for PALS Course

Day 1	
Introduction	3 Hours
Systematic Approach	
Team Performance	
Day 2 (Participants split into two groups)	
BLS Station	3 Hours
Management of Respiratory Emergencies	
Day 3	
Management of Arrhythmias (whole group)	3.5 Hours
Cardiac Station (small group)	
Shock Station (small group)	

Day 4 (Participants split into two groups)	
Respiratory and Shock station	2 Hours
Cardiac Station	
Day 5 (Participants split into two groups)	
Respiratory and Shock Testing	2 hours
Cardiac Testing	

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