Efficacy of Distance-Based EMS Education in a Low-Resource Country

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ABSTRACT

Introduction: Road traffic collisions are a major cause of morbidity and mortality in low-resource countries. Compounding this issue is a lack of advanced medical training in these regions and a paucity of developed emergency medical services (EMS). To help address this need, a distance-based EMS educational module was developed with the goal of advancing medical training in resource-poor areas.

Design: This prospective study evaluated the knowledge acquisition and technical effectiveness of a live online, distance-based EMS lecture provided to medical providers at Karl Heusner Memorial Hospital in Belize City, Belize. Participants were given a pretest consisting of 15 questions regarding ambulance and emergency vehicle safety, followed by a posttest of the same questions. One month later, a third test with the same questions was administered to assess knowledge retention. Technological effectiveness was evaluated as well.

Results: Nine participants completed all aspects of the study. Improvement was noted between the average scores of the pretest compared to the posttest (32.5% vs 74.1%) and was maintained from the pretest through the delayed posttest (32.5% vs 57.0%). Overall, participants approved of the technical aspects of the project.

Conclusions: This synchronously presented distance-based EMS educational program showed gains in both immediate and delayed knowledge acquisition among a small sample size. These results show promise that online, distance-based education is a viable option for continuing graduate medical education in low-resource countries.

INTRODUCTION

Road traffic collisions are a major cause of morbidity and mortality in low-income countries, especially when compared to the rates in high-income nations.[1] Nearly half of motor vehicle collisions are in low- to medium-resource nations, yet these nations account for 90% of all road fatalities.[1] The impact of these road traffic injuries is compounded by the physician shortage and lack of advanced medical training.[2] Indeed, countries with weak or poorly developed emergency medical services (EMS) have increased morbidity and mortality from preventable causes.[3] Furthermore, the lack of graduate medical education opportunities in these areas encourages recent graduates to emigrate in search of better educational opportunities.[2] Moreover, much of the medical world's attention has focused on the issue of infectious diseases in low-income countries, rather than attempting to solve a more fundamental problem: lack of medical infrastructure.[2]

Distance-based education is a platform to deliver a variety of training programs for diverse fields of study. An online, distance-based EMS educational program could further the medical knowledge of clinicians, ultimately leading to improved medical outcomes. However, the lack of evaluation of the effectiveness of this teaching tool in low-income countries, as well as the basic technical issues related to internet connection, present challenges to its implementation in these types of environments.[4,5]

The purpose of this study is to evaluate the effectiveness of an online, distance-based EMS educational program in a low-income country. We hypothesize that the development and presentation of a distance-based learning module will help to effectively translate EMS educational materials in a low-income clinical setting.

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METHODS

This was a prospective before-and-after intervention-based study approved by the Medical College of Wisconsin (MCW) Institutional Review Board, as well as the leadership of Karl Huesner Memorial Hospital (KHMH) in Belize City, Belize.

A group of emergency medicine providers from KHMH were recruited as participants. This site was selected due to previous educational partnerships and collaborations between MCW and KHMH and the fact that the main language in Belize is English.

Prior to the single educational intervention, participants took a 15-question pretest, custom-designed for this study, to assess a baseline level of knowledge in the area of ambulance safety (Appendix). The pretest was administered using a weblink and included protocol details and study goals and a stated consent to participation. The educational materials were presented live to the participants 1 time only, using an internet video hosting service, Skype, which included the ability for participants and the educator to chat live. As the lecture on ambulance safety was live-streamed to the participants, they were given the opportunity to ask questions and clarify materials that were presented. Lecture contents included the risks and contributing factors for patient, provider, and bystander injury from ambulance operation, as well as best practice recommendations for mitigation. Immediately after the session, participants were provided a posttest with the same previously administered questions to assess knowledge transfer. Approximately 1 month after the presentation, the questions were once again administered to assess knowledge retention.

Pretest, immediate posttest, and 1-month posttest results were compared to determine qualitative or quantitative differences. Tests were compared using a *t* test, with significance considered at a *P* value less than 0.05. The study design also incorporated a post-presentation survey to assess the technical success of the live lecture and to help troubleshoot any potential technical issues that may arise. The survey aimed to identify the participants' satisfaction with the quality of the slides, video, and audio, as well as the duration of the presentation. Aspects were rated on a 5-point scale, with "far exceeds expectations" scoring 5 points, "exceeds expectations" scoring 4 points, "equals expectations" scoring 3 points, "short of expectations" scoring 2 points, and "far short of expectations" scoring 1 point.

Inclusion criteria was emergency medicine providers at KHMH in Belize City. The study group was a convenience sample size, based on the number of attendees available, and was comprised of physicians, nurses, and other medical professionals.

RESULTS

Nine participants completed all portions of the study, including the post-lecture technical survey, the pretest, posttest, and 1-month follow-up test. A difference in scores was noted between the pretest and immediate posttest, and also between the pretest and the 1-month follow-up test (Table 1).

Table 1. Test Scores

Mean Test Scores (n=9)	
Pretest	32.5%
Immediate Posttest	74.1%
1-month delayed test	57.0%

Table 2. Technical Evaluation Scores

Mean Technical Evaluation Scores: Range 1-5 (n=9)	
Slide quality	3.44
Video quality	3.22
Audio quality	3.78
Duration of presentation	3.33

Box. Elements for Success

- Established, commercial telecommuting technology
- Testing of technology feasibility before implementation
- Synchronous format
- Ability to ask questions in real time
- Minimization of language barriers
- Measurable results through post test
- Consideration of delayed posttest to evaluate knowledge retention

The quality of the presentation was assessed with a 4-question post-lecture technical survey. Overall, participants were satisfied with all aspects of the presentation (Table 2).

DISCUSSION

The purpose of this study was to assess the feasibility of a distance-based learning platform to further EMS education in a low-income country. We were able to demonstrate an increase in knowledge acquisition with retention of knowledge. Additionally, the technological aspects and difficulties inherent in distance-based synchronous education did not appear to be a major issue.

Distance-based education has the ability to bridge a gap between high- and low-income nations and develop better medical systems in a symbiotic manner. Developing online modules and lecture series is a low-cost means of obtaining education in low-income countries, while providing opportunities for networking and collaboration with outside institutions. For low-income areas, distance-based education can provide high-quality education within the comforts of their own homes and hospitals. It is a cost-effective method of teaching, often only incurring marginal costs on the teaching institution, while utilizing technical resources such as computers and internet already in place at the learning facility.

Online global training programs in other areas of medicine have found promising results with respect to knowledge acqui-

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sition. As an example, a study among nephrologists in Latin America—a more robust education program—comprised of a 7-week asynchronous online modality was developed, with 442 physicians participating.[6] The vast majority of participants were satisfied with the program, and there was a significant increase in knowledge acquisition scores.[6]

Despite these successes, technical challenges have arisen when attempting to connect study staff to participants during online education. While our study showed no significant issues with the technology, this is not necessarily the norm. One study involving online education faced challenges with slow internet connection, website access restrictions, and difficulties logging into and accessing modules.[7] Predictably, these complicating issues were less apparent based on volume of online usage and age, as well as sex. The authors noted that high-volume online users and younger users (defined as <45 years old) were more comfortable using online resources, and younger users and women reported that online resources helped to improve work-life balance.[7] Another study dealt with the issues of establishing internet access in low-income settings. Without any previously establish technological infrastructure, the study team sent information technology support staffs and mobile internet then, eventually, established a broadband internet connection.[8] In our study, the utilization of Skype—a well-established, tested video conferencing software—as well as the live format with opportunities to ask questions and the ease of communication with same-language presenters and speakers, may have fostered the higher level of technical success (Box).

This study has several limitations. Notably, the small sample size makes drawing generalizable conclusions challenging, and the limited results of a single lecture on ambulance safety may not be generalizable to other areas of learning. Nevertheless, we were encouraged by the level of improvement in test scores, which we took to represent knowledge retention. Additional research with larger samples and a broader variety of topics would be assistive in further assessing the impact and effectiveness of this learning modality. Furthermore, while the 1-month follow-up did show a difference from the pretest, there was a decrease from the posttest score to the 1-month follow-up. Finally, our study evaluated synchronous distance-based learning in English language speakers. Depending on time zone differences, language barriers, and other logistical challenges, asynchronous learning and language translation may be required in many circumstances. Further research considering these barriers may be informative.

CONCLUSION

Overall, this project showed an encouraging start for a distance-based EMS educational program in a low-income country. It was able to highlight areas of knowledge deficits, identify a way to provide educational materials to address those areas, and revealed technical issues that could be improved. Further research with larger populations, more comprehensive curricula, and evaluating other barriers to learning may be warranted.

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Previous Presentations: Medical College of Wisconsin Pathways Presentation, National Association of Emergency Medical Services Physicians 2019, Consortium of Universities for Global Health 2019.

Appendix: Available online at wmjonline.org.

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Appendix: Ambulance Safety Test

You have been invited to participate in this online survey because you are an emergency medicine attending physician. We will be conducting a survey in order to help us better understand the utility of distance-based education as a teaching tool. Participation is voluntary and anonymous. We will not be collecting personally identifiable information in the survey; as a result, no identifiable information will be reported in the survey results. You will not be compensated for your participation in this survey. You may skip over any questions that you do not wish to answer. This survey will only take a few minutes and we appreciate your participation.

Additionally, your email address will be collected by study staff in order to send out 1-month follow-up surveys to gauge knowledge retention. Emails will be kept separate from study results on a password protected laptop. There will be no key to connect emails to study results. Emails will be disposed of following completion of the study.

By clicking the link, you will indicate your acceptance to participate in the study. The link will take you to the online survey.

If you have any questions, feel free to contact the study staff at lseymour@mcw.edu

- Accept
- Decline

What percent of EMS providers that are killed on the job die as a result of a vehicle accident?

- 2%
- 59%
- 32%
- 72%

Which of the following is NOT a current recommendation for improving safety?

- Limit moonlighting/other jobs
- Culture of shared responsibility
- 12-hour shift limit
- Transport exclusively with lights and sirens

Suggestions to improve ambulance safety include all of the following except

- Secure equipment
- Better ambulance visibility
- Back-up assistance
- Remove all hard and dangerous equipment

Which of the following is associated with a higher risk of mortality in ambulance crashes?

- Less educated providers
- Further distance from emergent care resources
- Slower speed limits
- Less educated patients

Which of the following is true of EMS providers seatbelt usage?

- Due to the weight of the ambulance, seatbelts do not play a major protective role in an accident
- Many EMS providers feel that seatbelts inhibit patient care
- Lights and siren usage makes serious accidents where seatbelts may be life saving, rare in ambulances
- None of the above

Which of the following has been identified as a contributing factor to increased EMS crashes?

- Seatbelt usage
- Diesel fumes
- Black boxes on ambulances
- Patient demographics

Fatigue increases the likelihood of an error occurring by what factor?

- 0.5-1x
- 2-3.6x
- 10-15x
- Fatigue does not increase the likelihood of an error occurring

What are the "4 E's" to help prevent accidents?

- Education, Engineering, Enforcement, Evaluation
- Education, Enactment, Enforcement, Evaluation
- Evaluate, Enactment, Effectiveness, Enforcement
- Education, Engineering, Enactment, Enforcement

Which of the following is considered a post-event factor affecting injury in an ambulance accident?

- Sharp objects
- Presence of hazardous materials
- Poor visibility
- Unsecured equipment

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Transporting with lights and sirens has been shown to be associated with all of the following EXCEPT

- Traffic congestion
- Delays in care
- Increased traffic accidents
- Poor patient satisfaction

What is the purpose of the Haddon Matrix?

- A tool used to evaluate factors occurring before, during, and after an event to enable injury prevention
- A protective cage to secure equipment in the event of an ambulance accident
- A method for training ambulance drivers proven to decrease accidents and increase efficacy
- A checklist used to ensure safe procedures are in place before an ambulance carrying a patient departs a scene

Which system has the highest crash mortality level?

- Fire-based
- Hospital-based
- Private utility
- Rural

This amount of wakefulness is equal to a blood alcohol level of 0.08%

- 10 hours
- 16 hours
- 21 hours
- 24 hours
- 36 hours

Which of the following is true of ambulance related MVCs?

- Those outside the ambulance have the highest risk of mortality
- Those inside the ambulance are rarely injured due to the weight of the ambulance
- Traveling with lights and sirens makes accidents less likely than routine travel
- They are exceedingly rare

Which of the following is true of seat belts in ambulances?

- They rarely make a difference in injury and mortality of the occupants
- They are typically ineffective in properly restraining the occupants
- They should not be used during transport as it can compromise the patient care
- Legislating seat belt use does have a major impact on usage

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