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Educational impact of a pilot paediatric simulation-based training course in Botswana

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ABSTRACT

Background As emergency medical services (EMS) systems develop globally in resource-limited settings, equipping providers with paediatric training is essential. Low-fidelity simulation-based training is an effective modality for training healthcare workers, though limited data exist on the impact of such training programmes. The objective of this study was to evaluate the paediatric portion of a simulation-based curriculum for prehospital providers in Botswana.

Methods This was a prospective cohort study of EMS providers from more populated regions of Botswana, who attended a 2-day training that included didactic lectures, hands-on skills stations and low-fidelity simulation training. We collected data on participant self-efficacy with paediatric knowledge and skills and performance on both written and simulation-based tests. Self-efficacy and test data were analysed, and qualitative course feedback was summarised.

Results Thirty-one EMS providers participated in the training. Median self-efficacy levels increased for 13/15 (87%) variables queried. The most notable improvements were observed in airway management, newborn resuscitation and weight estimation. Mean written test scores increased by 10.6%, while mean simulation test scores increased by 21.5% ($p<0.0001$). One hundred per cent of the participants rated the course as extremely useful or very useful.

Discussion/Conclusion We have demonstrated that a low-fidelity simulation-based training course based on a rigorous needs assessment may enhance short-term paediatric knowledge and skills for providers in a developing EMS system in a limited-resource setting. Future studies should focus on studying larger groups of learners in similar settings, especially with respect to the impact of educational programmes like these on real-world patient outcomes.

INTRODUCTION

Clinic and hospital-based interventions have reduced childhood mortality in low-income and middle-income countries, while many prehospital systems are non-existent or in their infancy.[1] Simple prehospital interventions may save lives, especially in paediatric patients. In 2015, the Botswana Human Development Index rank was 106 (medium human development category).[2] It was in this year that Botswana started their Ministry of Health and Wellness (MOHW) emergency medical services (EMS) programme in response to concerns about preventable prehospital deaths.[3] However, these prehospital providers have disparate training backgrounds and limited experience. Furthermore, the Botswana MOHW EMS specifically identified provider training in paediatric resuscitation as a critical need.

Simulation-based training has been useful in offering healthcare workers an effective way of developing clinical knowledge, procedural skills, teamwork and communication.[4–6] In addition, it has successfully been used to train prehospital providers, especially for paediatric resuscitation.[7–9] Consequently, improved outcomes have been observed at various impact levels.[10] In limited-resource settings, simulation-based training has been successful for several types of healthcare providers.[11–13] This is the first report of simulation-based training of EMTs in limited resource settings.

In response to the need for training, we previously developed a curriculum based on a prior needs assessment,[14] as well as communication with the Botswana EMS coordinator. The curriculum focused on the most common and high-risk prehospital scenarios and procedures for both adults and children. Collaborators iteratively developed the curriculum with feedback from global health, simulation and EMS experts, including in-country providers. The curriculum has since been implemented, and the objective of this study was to evaluate the paediatric portion of the simulation-based curriculum for prehospital providers in Botswana. Outcome measures included a change in provider satisfaction, self-efficacy, knowledge and performance on simulation-based testing.

METHODS

Study design

This was a prospective cohort study of the first group of participants in a simulation-based EMS course designed to address the educational needs of the Botswana MOHW EMS programme. The study was approved by the institutional review boards of Baylor College of Medicine (Houston, Texas, USA) and the Republic of Botswana MOHW Research and Ethics Committee (Gaborone, Botswana), and written consent was obtained from all participants.

Population and setting

At the time of the training in September 2015, the Botswana MOHW EMS programme consisted of six EMS stations in more populated regions of the country, staffed by approximately 115 EMS providers (doctors, emergency medical technicians (EMTs), nurses, healthcare assistants and drivers) in total.[3] These regions included Gaborone, Lobatse, Mahalapye, Palapye, Francistown and Phikwe. Most of these

Table 1 Characteristics of study participants

Characteristic	Frequency (%), n=31
Gender	
Male	19 (61)
Female	12 (39)
Study site	
Gaborone	11 (35)
Mahalapye	10 (32)
Francistown	10 (32)
Years in healthcare, median (IQR)	6.0 (3.0–8.0)
Years in EMS, median (IQR)	2.0 (1.0–2.0)
Prior life support training	
Basic life support	20 (65)
Intermediate life support	10 (32)
Paediatric advanced life support	4 (13)
Advanced or international trauma life support	10 (32)

EMS, emergency medical services.

EMS providers had prior training as either EMTs or registered nurses. The EMS stations provide coverage to the health districts where the EMS stations are located. Most parts of the country do not have access to formal EMS. Botswana has an area of 224 610 square miles and a population consisting of approximately two million people. These EMS providers respond to emergency calls in their jurisdictions and transport patients in ground ambulances only.

Intervention

The Botswana MOHW chose EMS providers who were not on active duty from all six stations to attend one of the 2-day mandatory trainings that were offered in three urban areas (Gaborone, Mahalapye and Francistown) of the country. In total, 31 (67.4%) of 46 prehospital providers in Botswana met eligibility criteria and participated in the study. Characteristics of the participants, including their years of experience are described in table 1. These EMS providers were invited to voluntarily participate in this research study by allowing their data to be collected and analysed.

The 2-day course involved 5 hours of instruction each day, and the paediatric portions of the curriculum included didactic lectures, hands-on skills stations and low-fidelity simulation training. Teaching materials were developed based on the results of a prior needs assessment by our team, which determined the most common patient conditions encountered by the EMS system.[12] This needs assessment was based on an analysis of prehospital calls in the busiest EMS centre (Gaborone) in Botswana in 2014. On average, the 33 employees of the Gaborone prehospital centre (2 doctors, 3 EMTs, 8 nurses, 10 healthcare assistants and 10 drivers) responded to approximately 12 000 calls in 2014, of which 8% were for paediatric patients.[12] The most common paediatric response calls were for respiratory distress, trauma, gastrointestinal complaints, newborn deliveries and seizure emergencies.[12] Didactic lectures covered an introduction to simulation, paediatric resuscitation, newborn delivery, neonatal resuscitation and trauma. Skills stations covered peripheral intravenous and intraosseous access, airway management, cardiopulmonary resuscitation and motion restriction for patients with trauma using cervical collars, backboards and splints. Simulations encompassed the management of respiratory distress and failure, diarrhoea/dehydration with hypovolaemic shock, trauma, neonatal resuscitation and seizure. Simulations were taught using rapid-cycle deliberate practice, allowing prompt feedback on performance throughout the scenarios, followed by the opportunity to immediately apply the feedback on the next round of scenarios.[15 16] Simulation equipment included manikins (ALS Baby, MegaCode Kid, and MegaCode Kelly; Laerdal Medical, Stavanger, Norway) as well as resuscitation supplies, including oxygen delivery devices, bag–valve–masks, intravenous and intraosseous equipment, and syringes to simulate medications.

Data collection

We collected data on three measures both before and after the course: self-efficacy of participants, performance on a written test and performance on a simulated resuscitation. Before the course, participants completed a demographic questionnaire and a self-efficacy survey of 15 topics covered in the course. On the self-efficacy survey, they rated their own confidence in performing a variety of paediatric skills using a 7-point Likert scale (1=extremely uncomfortable, 7=extremely comfortable; table 2). All participants also completed a 15-item written test composed of multiple-choice questions to assess their knowledge of paediatric prehospital assessment and management (see online supplementary appendix 1).

Each EMS provider individually participated in a simulated paediatric resuscitation of a patient presenting with signs of shock, who also required airway management due to respiratory failure. Since most EMS providers would respond to calls with a partner, each participant was paired with a confederate partner who would follow the directions of the participant to assist in patient care. The confederate was instructed to only act when directed to do so and not to make any suggestions on the management of the case. The simulated resuscitations were video-recorded and later independently scored by two study investigators using a modified version of the Simulation Team Assessment Tool (STAT).[17] This tool was modified to account for small team size and differences in locally available resources, and it included 23 items, each scored on a scale from 0 to 2 (see online supple mentary appendix 2).

The participants did not receive feedback on their performance on the written pretest nor the simulated resuscitation scenario that was conducted prior to the course. At the end of the course, participants completed the self-efficacy survey, a written test and a slightly modified version of the original simulated resuscitation scenario, which was again video-recorded for subsequent scoring as described previously. The participants also completed a course evaluation at the end of the course.

Data analysis

Demographic data and the participants' overall rating of the course were summarised with descriptive statistics. We analysed the Likert-based self-efficacy data using the Wilcoxon signed-rank test. The scores from the written test were converted to a percentage, and the prescores and postscores for each participant were compared using the paired t-test. The video-recorded simulations were independently reviewed by two people using modified STAT scores. Twenty-three specific desired actions from the modified STAT were rated on a scale from 0 to 2 (see online supplementary appendix 2). These ratings were then used to compile a total score, with a percentage calculated out of a total of 46 points. The scores of the two reviewers were averaged, and an intraclass correlation coefficient (ICC) was calculated. If the two reviewers had >10% discrepancy in scores on a particular video, a third investigator also reviewed and scored the video. We

Table 2 Participants' reported self-efficacy before versus after training*

Paediatric knowledge or skill	n	Median pretraining score (IQR)	Median post-training score (IQR)	P value
Administering oxygen	31	7.0 (6.0–7.0)	7.0 (7.0–7.0)	p=0.01
Placing an airway adjunct	31	5.0 (4.0–6.0)	7.0 (6.0–7.0)	p<0.001
Administering rescue breaths	31	7.0 (6.0–7.0)	7.0 (7.0–7.0)	p=0.01
Suctioning the airway	31	6.0 (6.0–7.0)	7.0 (6.0–7.0)	p<0.001
Managing an upper airway obstruction	30	5.5 (5.0–6.0)	7.0 (6.0–7.0)	p<0.001
Managing a patient with asthma	31	6.0 (6.0–7.0)	7.0 (6.0–7.0)	p=0.02
Recognising signs of shock	31	6.0 (5.0–7.0)	7.0 (7.0–7.0)	p<0.001
Providing fluid resuscitation for shock	31	6.0 (6.0–7.0)	7.0 (7.0–7.0)	p<0.001
Performing chest compressions	31	6.0 (6.0–7.0)	7.0 (7.0–7.0)	p=0.003
Rapidly assessing a newborn	31	5.0 (4.0–6.0)	7.0 (6.0–7.0)	p<0.001
Recognising and managing respiratory distress in a newborn	29	5.0 (4.0–6.0)	7.0 (6.0–7.0)	p<0.001
Rapidly conducting a primary survey on a patient with trauma	31	5.0 (4.0–5.0)	6.0 (5.8–7.0)	p<0.001
Immobilising the cervical spine	28	6.0 (5.0–6.0)	7.0 (6.0–7.0)	p<0.001
Rapidly assessing an actively seizing patient	29	6.0 (5.0–7.0)	7.0 (6.0–7.0)	p=0.002
Using a length-based tape to estimate a child's weight	28	4.0 (3.0–5.0)	7.0 (6.0–7.0)	p<0.001

*Likert scale of 1 (extremely uncomfortable)–7 (extremely comfortable).

averaged the reviewers' percentage scores for each of the simulation videos, and we compared the prescores and postscores for each participant using the paired t-test. For both the written test and the simulated resuscitation videos, a 95% CI for the difference in scores was calculated. Excerpts from the qualitative feedback on the best aspects of and suggested changes for the course were tabulated by major themes. Since this was a pilot study of the first group of participants in this course and the decision was made to use a convenience sample of providers (all of whom were employed by the Botswana MOHW) based on the availability of EMS workers, a sample size was not calculated. The sample size could not be changed and all available EMS workers participated.

RESULTS

The initial paediatric training consisted of 31 prehospital providers employed by the Botswana MOHW (table 1). One hundred per cent of providers requested to participate in the training completed the training. Of those who participated, only 20 (65%) had completed basic life support training.

On the self-efficacy assessment of participants' perceived confidence with paediatric knowledge and skills, median self-efficacy levels increased for 13/15 (87%) variables queried (table 2). Median values for the administration of both oxygen and rescue breaths were at the maximum level (7=extremely comfortable) both before and after training.

The mean score for the written test increased by 10.6%, while the mean score for the simulation test increased by 21.5% (table 3). This difference was statistically significant for both written and simulation test ($p<0.0001$). Out of the 62 videos reviewed (31 participants each with a pretest and post-test), only four videos had greater than a 10% discrepancy in scores. The calculated ICC was 0.956 (95% CI 0.926 to 0.973).

At the end of each training, the participants were asked to provide feedback by rating the course as well as free text responses about their favourite part and possible changes in the course. One hundred per cent of the participants rated the course as extremely useful or very useful. Excerpts from the participants' postcourse evaluation are summarised by major themes in box 1.

Table 3 Written test and simulation-based evaluation

Method of evaluation	Mean pretest score (SD)	Mean post-test score (SD)	95% CI for the difference	P value
Written test	75.3% (9.6)	85.9% (7.2)	7.7 to 13.5	p<0.0001
Simulation	56.2% (13.0)	77.7% (8.4)	16.5 to 26.6	p<0.0001

DISCUSSION

In this educational study of providers who underwent simulation-based paediatric training in a developing EMS system in Botswana, we demonstrated an improvement in the confidence, knowledge and skills of the participants after completion of the training. Insufficient EMS provider training has been reported as a major weakness in developing EMS systems in other African countries, so the provision of effective training might exert a positive impact in a similar setting.[18 19] In the present study, we specifically assessed the impact of the training programme in Botswana using the first three levels in Kirkpatrick's model for evaluation of the training programme.[20] The model has four levels to assess the effectiveness of an educational programme by determining the learner's perception about satisfaction or self-efficacy with respect to the curriculum (level 1), whether they learnt what was taught (level 2), whether their behaviour demonstrated that they can apply what was taught (level 3) and whether changed learner behaviour results in a different real-world outcome after training (level 4).

Though participants' perceived overall confidence with paediatric knowledge and skills was high before the training, the observed change in specific areas and the qualitative feedback from the postcourse evaluation provided meaningful feedback that may inform how to implement the course in other similar settings. Significant improvements were observed in paediatric airway management (placing adjuncts and managing obstruction), newborn assessment and management, and using a length-based tape to estimate a child's weight. An increase in self-efficacy of these skills might be attributed to the opportunity for hands-on practice with each skill during the course relative to the providers' limited procedural experience before the training. Therefore, this may indicate the need to emphasise practice of these skills when teaching paediatrics to providers in developing EMS systems. The qualitative feedback obtained from the learners was another aspect of level 1 evaluation from Kirkpatrick's model, and it complemented the self-efficacy findings with respect to newborn resuscitation and managing respiratory distress in children.

Box 1 Qualitative postcourse feedback themes

What was the best part of the course?

Newborn resuscitation
- Learning how to manage a newborn child in respiratory distress.
- Assessment of paediatric and infant patients was interesting, especially the topics pertaining to the resuscitation of newborns. Initially, I wasn't sure what to do, but now I feel more confident.
- Review and practice the resuscitation of a newborn baby.
- I enjoyed the neonatal resuscitation portion.
- Simulation on the delivery and resuscitation of an infant.

Respiratory distress
- Review of paediatric asthma.
- Recognising and managing respiratory distress.

Trauma assessment and management
- Review of the primary trauma assessment skills training sessions.

Paediatric fluid management
- Information on paediatric fluid resuscitation and simulations.
- Learning maintenance and bolus fluid calculations for paediatric patients.
- Fluid resuscitation and intraosseous insertion.

General paediatric management principles
- Managing the sick infant/child. There are many changes and calculations when compared with adult patients.
- Learnt about paediatric emergency treatment and medication dosing.

Simulation as a teaching modality
- The simulation scenarios: real-life scenarios that we see every day, especially trauma.
- Practicing simulation scenarios and receiving feedback on how well performed.
- The best part was hands on participation of each learner.

Overall
- I'm extremely happy and ready to use the skills I've acquired.
- I am going to use what I learnt here to save lives.
- Generally, the course is being perfectly conducted.
- The course is fabulous.

What changes would you make to the course?

Supplement teaching with other modalities
- More theory before we get to the simulations.
- Teaching aids like videos would be helpful.

Increase duration
- I'd allocate more time to the course so that more materials, including cardiac conditions, can be covered.
- Increase the time/duration of the simulations to 1 week so that we adequately gain experience in a diversity of scenarios.

Provide concurrent life support training
- The course should provide advanced life support training/ certification.

Augment pharmacology training
- More training on use of paediatric medications used in prehospital setting.

Enhance realism of scenarios
- More practical simulations.
- Include the use of the delivery training manikin.

Although self-efficacy improved and the learner satisfaction was high, the critical measures of educational effectiveness in Kirkpatrick's model that were evaluated included levels 2 and 3: demonstrating that they learnt what they were taught and could apply the acquired knowledge. Specifically, the increase in the scores on both the written and hands-on simulation-based tests demonstrates that these EMS providers in Botswana acquired new knowledge and were able to apply it. Although these assessments were conducted immediately at the end of the course, the data from another study of EMS providers in South Africa showed that prior training is associated with enhanced future performance.[21] Assessing the providers long-term knowledge retention serves as a future opportunity for research.

This EMS curriculum involved developing a separate 2-day train the trainer course of six EMS providers (one from each of the main EMS centres in country) selected by the Botswana MOHW EMS programme. These trainers were the primary instructors for the main simulation course. Future train the trainers sessions are planned to provide for more instructors and to allow for biannual trainings for all Botswana MOHW EMS providers. Previously, similar models of sustainability in emergency medicine training have been successfully demonstrated through collaboration between high-income and low-income to middle-income countries.[22–25] All simulation equipment procured for this project remained with the Botswana MOHW EMS programme to allow for future trainings. Despite such collaborations, enhancing the availability of EMS, especially in rural areas, is challenging as the EMS systems develop in resource-limited settings.[26 27] Therefore, investing in training laypersons or other types of first responders, such as the police, may be beneficial.[28 29] In addition, as countries develop towards industrialisation, the causes of death have also shifted, thereby providing novel opportunities for early prehospital intervention.[30]

Our study does have several limitations. First, the number of EMS providers that participated in this pilot study was relatively small, and we could only enrol those that the Botswana MOHW was able to support to attend the training. Another limitation is the before and after comparison in our study design, since providing any education is likely to demonstrate an improvement after the training relative to the providers' knowledge and skills before the training. For feasibility reasons, we chose to provide the same education to all participants. While the curriculum was designed based on the educational needs that were previously assessed in the capital city,[14] it is possible that the educational programme might not entirely fulfil the needs of the learners in different cities in Botswana. Although we observed an improvement in both the written and simulation test scores, this study did not evaluate level 4 of Kirkpatrick's model in determining whether real-world outcomes in patients improved after the training. Finally, although we used a modified version of the previously validated STAT to score participant performance through video review of their simulations, the modified version of the tool was not validated. Modifications were made to align with the Botswana prehospital provider guidelines and resources available. We confirmed the current findings through independent review of the videos and by a third reviewer to resolve the scoring discrepancies.

CONCLUSION

A low-fidelity simulation-based training course based on a rigorous needs assessment may enhance short-term paediatric knowledge and skills for providers in a developing EMS system in a limited-resource setting. The most notable improvements were observed in airway management, newborn resuscitation and weight estimation. Future studies should focus on studying larger groups of learners in similar settings, especially with respect to the impact of educational programmes like these on real-world patient outcomes.

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Contributors NWG, MIS, AAK, CBD, CG, BL and MCR made substantial contributions to the conception and the design of the project, participated in the drafting and revision of the work and the data analysis required to complete the project, and approved the final version of the manuscript and agrees to be accountable for all aspects of the work. NG was the principal investigator for this study and MCR served as the senior author of the manuscript.

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Competing interests None declared.

Ethics approval This study was approved by the institutional review boards of Baylor College of Medicine (Houston, Texas, USA), University of California, San Francisco, and the Republic of Botswana Ministry of Health and Wellness Research and Ethics Committee (Gaborone, Botswana). Written consent was obtained from all participants.

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REFERENCES

1 Mould-Millman N-K, Dixon JM, Sefa N, *et al*. The state of emergency medical services (EMS) systems in Africa. *Prehosp Disaster Med* 2017;32:273–83.
2 Human development indices and indicators. Statistical update. UNDP, 2018. Available: http://hdr.undp.org/sites/default/files/Country-Profiles/BWA.pdf
3 Personal communication with Laba, B. chief health Officer/EMS coordinator, Botswana MOHW EMS 2014.
4 Cheng A, Hunt EA, Donoghue A, *et al*. Examining pediatric resuscitation education using simulation and scripted Debriefing: a multicenter randomized trial. *JAMA Pediatr* 2013;167:528–36.
5 Issenberg SB, McGaghie WC, Petrusa ER, *et al*. Features and uses of high-fidelity medical simulations that lead to effective learning: a BEME systematic review. *Med Teach* 2005;27:10–28.
6 McGaghie WC, Siddall VJ, Mazmanian PE, *et al*. Lessons for continuing medical education from simulation research in undergraduate and graduate medical education. *Chest* 2009;135:62S–8.
7 Abelsson A, Rystedt I, Suserud B-O, *et al*. Mapping the use of simulation in prehospital care – a literature review. *Scand J Trauma Resusc Emerg Med* 2014;22:22.
8 Doughty C, Pearson N, Mondragon J, *et al*. Simulation-Based pediatric resuscitation curriculum for prehospital providers. *MedEdPortal* 2014;10.
9 Lammers RL, Byrwa MJ, Fales WD, *et al*. Simulation-Based assessment of paramedic pediatric resuscitation skills. *Prehosp Emerg Care* 2009;13:345–56.
10 Shah MI, Carey JM, Rapp SE, *et al*. Impact of high-fidelity pediatric simulation on Paramedic seizure management. *Prehospital Emergency Care* 2016;20:499–507.
11 Shilkofski N, Crichlow A, Rice J, *et al*. A standardized needs assessment tool to inform the curriculum development process for pediatric resuscitation simulation-based education in resource-limited settings. *Front Pediatr* 2018;6.
12 Bulamba F, Sendagire C, Kintu A, *et al*. Feasibility of simulation-based medical education in a low-income country: challenges and solutions from a 3-year pilot program in Uganda. *Simul Health* 2019;14:113–20.
13 Kamath-Rayne BD, Thukral A, Visick MK, *et al*. Helping babies breathe, second edition: a model for strengthening educational programs to increase global newborn survival. *Glob Health Sci Pract* 2018;6:538–51.
14 Glomb NW, Kosoko AA, Doughty CB, *et al*. Needs assessment for simulation training for prehospital providers in Botswana. *Prehosp Disaster Med* 2018;33:621–6.
15 Taras J, Everett T. Rapid cycle deliberate practice in medical education - a systematic review. *Cureus* 2017;9.
16 Eppich WJ, Hunt EA, Duval-Arnould JM, *et al*. Structuring feedback and Debriefing to achieve mastery learning goals. *Acad Med* 2015;90:1501–8.
17 Reid J, Stone K, Brown J, *et al*. The simulation team assessment tool (STAT): development, reliability and validation. *Resuscitation* 2012;83:879–86.
18 Balikuddembe JK, Ardalan A, Khorasani-Zavareh D, *et al*. Weaknesses and capacities affecting the prehospital emergency care for victims of road traffic incidents in the greater Kampala metropolitan area: a cross-sectional study. *BMC Emerg Med* 2017;17:29.
19 Nicholson B, McCollough C, Wachira B, *et al*. Emergency medical services (EMS) training in Kenya: findings and recommendations from an educational assessment. *Afr J Emerg Med* 2017;7:157–9.
20 Kirkpatrick DL. *Evaluating training programs: the four levels*. 2nd edn. San Francisco, CA: Berrett-Koehler, 1998.
21 Alenyo AN, Smith WP, McCaul M, *et al*. A comparison between differently skilled prehospital emergency care providers in major-incident triage in South Africa. *Prehosp Disaster Med* 2018;33:575–80.
22 El-Shinawi M, McCunn M, Sisley AC, *et al*. Developing sustainable trauma care education in Egypt: sequential trauma education program, steps to success. *J Surg Educ* 2015;72:e29–32.
23 Martel J, Oteng R, Mould-Millman N-K, *et al*. The development of sustainable emergency care in Ghana: physician, nursing and prehospital care training initiatives. *J Emerg Med* 2014;47:462–8.
24 Yano V, Ueda M, Dever G, *et al*. The Pacific center for emergency health: an anatomy of collaborative development and change-the Palau perspective. *Pac Health Dialog* 2002;9:130–3.
25 Pirrallo RG, Wolff M, Simpson DE, *et al*. Analysis of an international emergency medical service train-the-trainer program. *Ann Emerg Med* 1995;25:656–9.
26 Sun JH, Shing R, Twomey M, *et al*. A strategy to implement and support pre-hospital emergency medical systems in developing, resource-constrained areas of South Africa. *Injury* 2014;45:31–8.
27 MacFarlane C, Loggerenberg Cvan, Kloeck W. International EMS systems in South Africa: past, present, and future. *Resuscitation* 2005;64:145–8.
28 Solagberu BA, Ofoegbu CK, Abdur-Rahman LO, *et al*. Pre-Hospital care in Nigeria: a country without emergency medical services. *Niger J Clin Pract* 2009;12:29–33.
29 Olumide AO, Asuzu MC, Kale OO. Effect of first aid education on first aid knowledge and skills of commercial drivers in South West Nigeria. *Prehosp Disaster Med* 2015;30:579–85.
30 Hess A, Thomas T, Contreras R, *et al*. Development of emergency medical services in Guatemala. *Prehosp Emerg Care* 2004;8:308–12.