

Training Laypersons and Hospital Personnel in Basic Resuscitation Techniques: an Approach to Impact the Global Trauma Burden in Mozambique

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Abstract

Introduction Over half of prehospital deaths in low-income countries are the result of airway compromise, respiratory failure, or uncontrolled hemorrhage; all three conditions can be addressed using simple first-aid measures. For both hospital personnel and laypersons, a basic trauma resuscitation training in modified ABCD (airway, breathing, circulation, disability) techniques can be easily learned and applied to increase the number of first responders in Mozambique, a resource-challenged country.

Methods A trauma training session was administered to 100 people in Mozambique: half were hospital personnel from 7 district medical centers and the other half were selected laypersons. This session included a pre-test, intervention, and post-test to evaluate and demonstrate first response skills.

Results Eighty-eight people completed both the pre- and post-tests. Following the education intervention, both groups demonstrated an improvement in test scores. Hospital personnel had a mean post-test score of 60 % (SD = 17, N = 43) and community laypeople had a mean score of 51 % (SD = 16, N = 45). A *t* test for equal variances demonstrated significant difference between the post-intervention scores for the two groups ($p = 0.01$). All 100 participants were able to open an airway, externally control hemorrhage, and transport a patient with appropriate precautions.

Conclusion The trauma training session served as new information that improved knowledge as well as skills for both groups, and increased the number of capable responders in Mozambique. This study supports WHO recommendations to utilize the strengths of a developing nation—population—as the first step in establishing an organized trauma triage system.

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Introduction

Injury burden continues to grow similar to communicable diseases in developing nations, with more than five million deaths yearly and 1.24 million of these due to road traffic injury [1]. The cost of trauma remains exorbitant, accounting for over 300 million years of healthy life, along with 11 % of disability-adjusted life years (DALYs) worldwide and an economic cost of \$518 billion [2, 3]. The World Health Organization (WHO) has indicated improving outcomes of emergent surgical conditions including trauma as essential [4].

Reduction of trauma related DALYs and mortality are linked to adequate pre-hospital care and decreased transport times to definitive care. The WHO recommends a model trauma system policy that includes oversight, pre-hospital care, facility-based trauma care, and surveillance. Unfortunately, barriers to implementation in resource-poor countries include inadequate infrastructure, equipment, and qualified personnel.

It is estimated, that of all trauma patients who die, 81 % die in the field in a low-income setting compared to 59 % in a high-income setting [5]. Given the financial and resource constraints in low-income countries, simple but systematic pre-hospital training programs have been implemented in rural villages to stabilize patients. Most pre-hospital deaths are the result of airway compromise, uncontrolled hemorrhage, or transport delays; all three of these conditions can be addressed in the field using basic first-aid measures [6].

Mozambique is a Portuguese-speaking country along the southeast coast of Africa with a population of 25.2 million people [7]. The literacy rate is 67 %, and GDP per capita is \$593. The birth rate is 38 per 1,000 people. The maternal mortality ratio per 100,000 people is 480. There are 979 physicians in the country, with a density of 0.39 per 10,000 [8]. Thirty-two percent of the population lives in urban areas.

There are 1,200 rural posts, 2 district and rural hospitals as well as 9 provincial and 3 central hospitals [9].

Trauma remains a growing cause of morbidity and mortality in Mozambique. Like many developing nations, Mozambique has experienced a large increase in trauma from RTIs with increased motorization. Pedestrians alone accounted for 55 % of road traffic deaths in Mozambique from 1993 to 2000. Collisions in Maputo City are less fatal than in other provinces, likely due to lower speed limits and quicker treatment of injured patients thanks to multiple health care centers [10–12].

For both hospital personnel and laypersons, a basic trauma resuscitation training in ABC techniques can be easily learned and applied in Mozambique, a resource-challenged country to increase the number of competent providers.

Materials and methods

Following ethics approvals from both the Inter-Institutional Committee for Bioethics in Health—Zambézia (*Comité Inter-Institucional de Bioética para Saúde da Zambézia*) and the Vanderbilt University IRB, a trauma training protocol was field tested in the Zambézia Province of Mozambique in both hospital and community settings. Throughout this study, participants did not receive financial compensation to take the course or tests. Only snacks were provided at the end of each session. All district hospitals with surgical capacity (both general and obstetrics) were evaluated, which totaled seven hospitals in Zambézia. Two hospitals without surgical capacity were chosen based on isolation and evaluation of trauma capacity when travel times require multiple modes of transportation or unpaved roads. The trauma training course was altered in each hospital based on resources noted in the assessment. For example, two hospitals did not maintain stocks of oxygen; thus, their airway training involved how to adequately open and clear an airway only. For hospitals with ambu bags and oxygen, personnel were trained how to administer oxygen effectively. The trainees were selected by hospital directors based on their time and interaction in hospital triage. Laypersons were selected through convenience sampling in each community based on participant interest and affiliation with community health care partners. In one community, Mopeia, twelve community members could not complete the pre- and post-test due to technical issues (no light available to read the questions).

The trauma resuscitation training program utilized a modified first-aid curriculum based on challenges of pre-hospital care noted in other African countries such as Ghana and Uganda. The curriculum included modified ABCDs (airway, bleeding, circulation, cervical spine). It covered scene management, airway and hemorrhage control, safe transportation, cervical spine precautions, and splinting fractures [13]. As mentioned, for hospital personnel, the course used items available to the staff such as oxygen and gauze. For laypersons, training included items found easily such as tree leaves to apply direct pressure for hemorrhage control, cloth with pens to apply a tourniquet to an extremity, and a capulana (a cultural sheet wrapped around most women in Mozambique as another layer of clothing) to transport patients in supine position, stabilize fractures, and control hemorrhage. Hospital personnel received additional training in oxygen administration for airway management where applicable and IV fluid administration as part of circulation. As in similar studies, training did not include CPR as it is unlikely to be effective in resource-poor settings [14]. The course was conducted in Portuguese, the national language of Mozambique, and lasted 2.5 hours. For each of the tasks, participants were shown how to perform the task; next, they had to model the behavior; finally, they received

1:1 feedback from the course instructor. This process was repeated for any deficiencies in task performance until satisfactory demonstration to the course instructor. Participants utilized each other to practice basic life-saving techniques; thus, they received feedback from both their co-participants as well as the instructor. After every participant was able to demonstrate all techniques, a trauma scenario was trialed. Each participant was given a motor vehicle collision scenario and had to demonstrate on their peers as well as in front of them the full process of trauma resuscitation in order of importance. Each participant demonstrated scene and airway management, hemorrhage control based on situation (tourniquet use vs direct pressure), cervical-spine immobilization, fracture splinting, and safe transport utilizing the common materials previously mentioned. After this hands-on session, the course included a pre- and post-test to assess the fund of knowledge and whether the course was useful. The tests required minimal literacy skills to read the questions. It involved 12 questions that tested basic knowledge about ABCDs and specifics on techniques for hemorrhage control and cervical spine precautions. The teaching sessions included demonstrating the ABCD techniques to the trainees, allowing them time to practice on each other using the resources available, and giving immediate feedback to gain competence (Table 1).

All data were analyzed using SPSS. A preliminary test for the equality of variances indicated that the variances of the two groups was not significantly different. Therefore, a two-sample *t* test was performed on the individual pre-intervention test scores of the groups and the individual post-intervention test scores of the groups. A paired *t* test was performed to evaluate for significant difference between the pre- and post-intervention test scores for all comers.

A total of 100 people received the trauma training intervention across 7 communities in Zambézia Province of Mozambique, with 88 people able to complete written pre- and post-testing (Table 2). All study participants were native Mozambicans over the age of 18 years.

Results

At baseline prior to the trauma education intervention, we observed low mean test scores in both community

laypeople and hospital personnel. Community laypeople had a mean score of 27 % (SD = 15, *N* = 45) and hospital personnel had a mean score of 42 % correct (SD = 16, *N* = 43) (Table 3). The cumulative mean of the pre-intervention test scores for both groups was 34 %. Using a student's *t* test for equal variances, we found that the mean score for community laypeople was significantly smaller than the scores for hospital personnel ($p < 0.001$). Following the education, both groups demonstrated an improvement in test scores. Hospital personnel had a mean score of 60 % (SD = 17, *N* = 43) and community laypeople had a mean score of 51 % (SD = 16, *N* = 45) (Table 3). A *t* test for equal variances demonstrated significant difference between the post-intervention scores for the two groups ($p = 0.01$). The cumulative mean post-intervention score for all comers was 55 %.

When comparing between the community laypersons group and the hospital personnel group, we found that although the hospital personnel had higher mean pre- and post-intervention scores, community laypeople had a higher difference in test scores, with a mean of 24 % increase (SD = 15, *N* = 45) compared to a mean of 18 % increase in hospital personnel. However, there was no statistical significant difference in the percent increases of the test scores for the two groups ($p = 0.09$).

For all comers, there is a 21 % mean increase in the pre- and post-intervention test scores (SD = 16, *N* = 88). There is significant difference between the two tests ($p < 0.001$).

Discussion

Low and middle-income countries (LMICs) have a disproportionate trauma burden and pre-hospital death due to lack of infrastructure and emergency medical services in the post-trauma phase. In particular, the absence of established emergency response systems contributes to a significant share of trauma deaths and disability. Long travel times to urban centers, few ambulances, and few trained personnel in the rural areas contribute to prehospital mortality and increased disability rates for treatable conditions [15, 16]. Without trained health personnel, low-income countries such as Mozambique must attempt to reduce

Table 1 Basic ABCD Interventions Taught to Participants

Intervention (ABCD)	Layperson	Hospital personnel (in addition to layperson interventions)
A—airway	Open mouth, remove foreign objects	Administer oxygen, obtain vital signs
B—bleeding	Direct compression, tourniquet application	Peripheral IV placement
C—cervical spine	Cervical spine immobilization	Cervical spine immobilization and appropriate transport
D—disability	Flat, immobile transport, splint fractures	Intravenous fluid resuscitation if blood pressure < 120/80

Table 2 Distribution of study participants for written questions

Town	N	%
Alto Molóquè	6	6.8
Chinde	37	42.0
Gilé	7	8.0
Mocuba	6	6.8
Moopia	6	6.8
Morrumbala	12	13.6
Quelimane	14	15.9
Total	88	100

Table 3 Comparison of Hospital personnel and Community laypersons

Topic	N	Pre-intervention % correct	Post-intervention % correct
Hospital personnel	43	42	60
Community laypersons	45	27	50

trauma mortality in both pre-hospital and district triage stages. As the burden of trauma grows, it is essential to intervene early with life-saving strategies at the time of injury to improve outcomes. It has been established that ACLS and BLS teaching does not improve outcomes in low-income countries that do not have adequate resources. All but one hospital surveyed did not have capacity for intubation and ventilation outside of the operating room. Many hospitals did not have a large enough supply for blood products if a massive resuscitation was needed, as they often are required in developed countries. Thus, it is impractical to teach ACLS, BLS, and even ATLS in rural hospitals that do not have equipment the WHO deems necessary. Instead, we decided to survey the hospital and utilize the resources available to those personnel in the specific community to make meaningful changes in practice that are proven to save lives.

In Cambodia and northern Iraq, basic life support techniques were taught to local people motivated to assist their communities. Utilizing local language, culture, and instructors, pre-hospital mortalities from landmine injuries were reduced from 40 % to <10 % [17]. In Uganda, over 300 trainees consisting of police officers, taxi drivers, and community leaders completed a one-day basic pre-hospital trauma care program. They were followed for 6 months and effectively retained knowledge of pre-hospital trauma care and easily utilized their learned skills as well as supplies. In Madagascar, a one-day course was implemented to teach taxi drivers how to manage a trauma scene, control bleeding, stabilize fractures, transfer patients, and position women for delivery. This first-responder training program

improved the comfort levels of taxi drivers and served as a low-cost approach to providing pre-hospital care [18].

These examples showed that in a low-resource environment, simple techniques can be taught to laypersons to improve pre-hospital care when trained personnel are scarce [19].

Our study addresses improvements that can be made in both the pre-hospital and rural district hospital setting through a basic trauma education of both hospital personnel and laypeople in Mozambique. Our pre-intervention questionnaire demonstrated a lack of knowledge regarding basic trauma resuscitation skills, with laypeople answering less than 1/3 of questions (27 %) correctly about airway, bleeding, and c-spine interventions and hospital personnel answering only a slightly higher percentage correct of 42 %. It is difficult to assess whether the community group had a true deficit in knowledge, or if their scores were affected by external factors such as the ability to read. In addition, participants may have never been exposed to such wording or questions. After the education, however, both hospital personnel and community laypeople showed an increase in their knowledge by demonstrating improved test scores and the ability to model behavior. These results underscore both an initial lack of knowledge about basic trauma resuscitation skills as well as a potential to improve and retain information about these skills. In addition, these results show the need for standardized training of hospital personnel about trauma triage and evaluation of injuries at the district hospital. Currently, no official standardized training regarding trauma patient care is offered to hospital personnel who triage patients from nurses to physicians. No medical education incorporates evaluation of a trauma patient, though road traffic injury remains one of the top causes of mortality in Mozambique and other developing nations.

Moreover, both hospital personnel and community laypeople found the intervention to be useful and accessible. One-hundred percent of participants were able to observe the behavior, model the skill, and accept feedback regarding ways to improve their skill set. Every participant was able to demonstrate scene management, open an airway, apply direct pressure, or a tourniquet to stop bleeding, splint fractures, and transport a patient with appropriate cervical spine immobilization and in supine position. In addition, all hospital personnel were able to verbalize and incorporate the initiation of intravenous fluid resuscitation and applying oxygen to a trauma patient resuscitation. These observations suggest that this knowledge-based test may not reflect ability to perform ABCDs in trauma management. However, interactive modeling serves as a method of teaching both laypeople and hospital personnel how to perform an initial trauma resuscitation. As the strength of many developing nations includes its large

populations, this pilot study shows lay people and hospital personnel with minimal exposure to trauma can learn how to triage and transport patients. Planning is currently underway to design systems for monitoring patient outcomes in communities following further scale-up of this trauma education intervention.

There remain many limitations to this study. The questions are biased toward a Western mindset of ABCD methodology of approaching trauma. However, the WHO international trauma training also provides this same approach. The sample size is small, and there was no control group utilized for testing.

Basic trauma resuscitation techniques are unknown to most laypeople and hospital personnel in LMICs. ATLS is beyond the scope of what is needed initially for much of the untreated trauma in LMICs and has not been shown to impact outcomes. The basic techniques taught in this pilot study were easily teachable and every participant was able to demonstrate basic, modified ABCD techniques. These techniques, if embraced by the lay public and rural healthcare workers, have the potential to impact early trauma mortality and increase the likelihood of survivable transport to a higher level of care. The results of this training support WHO efforts already in place on essential and emergency surgery and the need for surgery at the district hospital level. The results of the intervention support utilizing community members to provide simple, reproducible, and effective life and limb-saving interventions in a community that lacks medical resources. Advocating for improved surgical infrastructure and utilizing novel methods to improve trauma outcomes is the end goal of this process. In addition, training hospital personnel in basic resuscitation techniques will increase the capacity of physicians and nurses to deliver adequate trauma care and contribute to the development of an organized trauma triage system.

Conflict of interest None.

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