Piloting a Layperson Prehospital Care System in Rural Uganda

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Abbreviations:
EMS: Emergency Medical Services
LMIC: low- and middle-income countries
MKMC: Masindi Kitara Medical Center
RTI: road traffic injury

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Abstract

Introduction: In many low-income countries, basic prehospital Emergency Medical Services (EMS) remain under-developed, resulting in significant delays or the complete inability to access care.

Study Objective: The purpose of this study was to analyze the effectiveness of a layperson EMS training targeting motorcycle taxi (boda) drivers in a rural region of Uganda.

Methods: Fifty (50) adult boda drivers from Masindi, Uganda were selected for a one-day training course including lectures and simulation. Course content covered basic prehospital skills and transport. Participants were given a first responder kit at completion of the course. Understanding of material was assessed prior to training, immediately after course completion, and four months from the initial course using the same ten question test. Test means were analyzed using a standard linear regression model. At the four-month follow up, all 50 boda drivers participated in semi-structured small group qualitative interviews regarding their perception of the course and experiences implementing course skills in the community. Boda drivers were asked to complete a brief form on each patient transported during the study period. For patients transported to Masindi Kitara Medical Center (MKMC), hospital trauma registry data were analyzed.

Results: Trainees showed both knowledge acquisition and retention with pre-test scores of 21.8% improving to 48.0% at course completion and 57.7% at the four-month follow up. Overall, participant's scores increased by an average of 35% from the pre-test to the second post-test ($P < .001$). A total of 69 patient forms were completed on transported patients over the initial four-month period. Ninety-five percent (95%) of these were injured patients, and motorcycle crash was the predominant mechanism of injury (48% of injuries). Eight patients were transported to MKMC, but none of these patients were recorded in the hospital trauma registry. Major barriers identified through semi-structured interviews included harassment by police, poor road conditions, and lack of basic resources for transport. Ninety-four percent (94%) of trainees strongly agreed that the training was useful. Total costs were estimated at $3,489 USD, or $69 per trainee.

Conclusion: Motorcycle taxi drivers can be trained to provide basic prehospital care in a short time and at a low cost. While there is much enthusiasm for additional training and skill acquisition from this cohort, the sustainability and scalability of such programs is still in question.

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Introduction

Injury is a significant cause of death and disability world-wide and is responsible for one in every ten deaths across the globe.[1] Low- and middle-income countries (LMIC) are disproportionately affected by injury with more than 80% of injury-related deaths occurring in these countries.[2] Road traffic injuries (RTIs) alone are the eighth leading cause of death world-wide and global mortality from RTIs has increased over the past 15 years.[3] Uganda is classified by the World Bank (Washington, DC USA) as a low-income country and exemplifies the challenges of mitigating injury-related death and disability in this setting.[4] Thirteen percent (13%) of all deaths in Uganda are caused by injury.[5] Road traffic injuries alone account for more than 10,000 deaths annually in Uganda and is the country's eighth most common cause of death.[6]

Despite the increasing mortality burden caused by injury, prehospital care remains under-developed or non-existent in many LMICs, including Uganda.[7,8] Injured patients

presenting to a health care facility in Uganda usually do so by private vehicle, with less than five percent of patients arriving by ambulance and one out of three arrive outside of the first hour after the injury when medical intervention is most likely to be life-saving.[9,10] The World Health Organization (Geneva, Switzerland) recommends training laypersons in basic first aid interventions to care for injury victims in areas where prehospital care is still lacking.[11] Programs in several LMICs have utilized informal, pre-existing networks who frequently encounter trauma victims, such as commercial drivers, police, school teachers, and local government officials, and successfully provided basic first aid training to these groups.[12]

Commercial drivers are a common target for layperson first responder training, as ill and injured patients in many areas rely on them for transport to medical facilities. Motorcycle taxis are a common means of transportation in LMICs, particularly in rural and more difficult to access areas. First responder training specifically targeting motorcycle taxi drivers has previously been described.[13–15] Previous layperson first responder programs have demonstrated knowledge gain and increased confidence in caring for injured patients.[12,14–17] Several studies used incident reports to track the most common injuries, care rendered in the field, and facility where patients were transported.[12,14,15,17]

Unfortunately, few of these studies have been able to track patients beyond transport to determine if these programs have an effect on patient outcomes.[12] The purpose of this study was to access the feasibility of a low-cost layperson first responder training program targeting motorcycle taxi (boda) drivers in a rural region of Uganda. In addition, this study sought to utilize a pre-existing, hospital-based trauma registry to compare in-patient outcomes for those transported and cared for by the trained boda drivers with those injured patients arriving by private vehicle.

Methods

Masindi is a rural district of Uganda approximately 217km northwest of Kampala. Masindi Kitara Medical Center (MKMC) is a 35-bed hospital founded by the nongovernmental organization OneWorld Health (Charleston, South Carolina USA) and provides 24-hour services on a sliding-scale, fee-for-service basis. Along with the larger Masindi Government Hospital, MKMC serves the 291,000 residents of Masindi District,[18] and it has gained a reputation in the district for high-level quality care of trauma patients in part due to providing annual trainings open to providers throughout the district. They have maintained a hospital-level trauma registry since 2017, which has been previously described in detail.[19]

Fifty (50) adult boda drivers from various parts of Masindi were selected for a one-day training course including lectures and small group simulation. Course participants were recruited through the boda driver association and chosen to cover a large portion of the Masindi district. All boda drivers participated on a voluntary basis and received a first-aid kit, full-face motorcycle helmet, and a small stipend of 24,500 Ugandan shillings (approximately $6.50 USD) to cover the opportunity costs related to the training. Training occurred over a two-day period at MKMC with 25 boda drivers receiving the same training on each day.

Training was adapted from multiple sources and adapted specifically for the Masindi context.[20–22] Course content covered basic prehospital skills and transport, including scene safety, airway maneuvers, splinting, and hemorrhage control. The training consisted of several lectures using PowerPoint (Microsoft Corp.; Redmond, Washington USA) given in English with a Runyoro translator, as well as several small group practical sessions also utilizing Runyoro translators. At the conclusion of the training, each participant was given a basic first responder kit (Table 1). Understanding of material was assessed prior to training, immediately after completion of training, and four months from the initial course using the same ten question written test. Test means were analyzed using a standard linear regression model.

Item (Number)	
Gloves (2 pair)	Tourniquet (1)
Surgical Mask (2)	Trauma Sheers (1)
Roll of Tape (1)	Ballpoint Pen (1)
Gauze (1 roll)	Ace Wrap (2)
Chest Seal (1)	

Table 1. First-Aid Kit Contents

In addition, boda drivers were asked to complete a brief form on each patient transported over the four-month period. Patients were included if transported by a trained boda driver to any medical center and seeking treatment for an injury. All ages and all traumatic complaints were included. Patients were excluded if transported for medical complaints or if the boda driver did not perform an assessment or intervention on the patient. Patient forms were adapted from those described by Jayaraman, et al with no identifiers and both English words and pictures.[9] A locked box was placed at MKMC and easily accessible to the boda drivers to deposit the cards when dropping a patient at MKMC. Boda drivers were also provided the opportunity to restock their first aid kit at these times. For patients transported to MKMC, patient forms were to be handed to the triage nurse and stapled to the hospital's paper registry form instead of being placed in the drop box. At the end of the four-month study period, paper registry forms were transferred into an electronic database. Patient demographics, time to presentation, reasons for delay in presentation, injury severity, diagnosis, and final disposition were extracted for patients transported by trained boda drivers.

Four months after the training, all 50 boda drivers participated in semi-structured small group qualitative interviews regarding their perception of the course and their experiences implementing the course skills in the community. At the four-month follow up, each participant was also asked to complete an eight-question survey. Four of the questions assessed utility of the training and skill confidence using a five-point Likert scale. The remaining questions assessed equipment used, number of patients transported, and how often patient forms were being completed (Table 2).

The study was approved by the Prisma Health Institutional Review Board (Pro00081465; Columbia, South Carolina USA), The AIDS Support Organization of Uganda's ethics committee (19-UG-REC-009; Kampala, Uganda), and the Uganda National Council of Science and Technology (HS414ES; Kampala, Uganda). Funding for this project was provided by Prisma Health's grant-in-aid program and in-kind donation of supplies from North American Rescue (Greer, South Carolina USA).

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Results

Trainees showed both knowledge acquisition and retention over the study period with pre-test scores of 21.8% improving to 48.0% at course completion and 57.7% at the four-month follow up. Overall, participant's scores increased by an average of 35% from the pre-test to the second (four-month) post-test ($P < .001$). A total of 69 patient forms were completed on transported patients over the initial four-month period. Three (4.3%) of the patients were transported for a medical complaint and excluded from the study. The remaining 66 were injured patients, and motorcycle crash was the predominant mechanism of injury (48% of injuries). Gloves were the most commonly used item from the first-aid kits, followed by gauze and ace wraps. No tourniquets were used in the four-month period. Bleeding control was the most commonly reported skill used, followed by ABCs and limb splinting.

The majority of patients (28 or 42.4%) were transported to Masindi Government Hospital and eight (12.1%) patients were transported to MKMC. The facility to which the patient was transported was not recorded for 17 (25.7%) patients, and the remainder of patients were transported to a variety of private clinics, hospitals, and government hospitals in neighboring districts.

All 50 boda drivers returned to MKMC four months after the initial training for retention testing, kit restocking, and semi-structured qualitative interviews about their experience providing basic prehospital care. Semi-structured interviews were conducted in small groups at the four-month follow up at MKMC. Major themes identified during the interviews included a desire for more frequent and advanced training, need for more advanced transport methods for ill patients, and need for more trained boda drivers to cover the large Masindi district. Major barriers identified through the interviews included harassment by local police unfamiliar with the training, poor road conditions, and lack of basic resources such as stretchers (Table 3).

Forty-eight (48) of the 50 participants completed the survey during the four-month follow up. Ninety-six percent (96%) of trainees strongly agreed that the training they had received was useful and 94% strongly agreed that they felt prepared to use the skills they learned during the training. All but one participant strongly agreed they would like to continue the training in the future and that the equipment provided to them was useful (Table 2). Ten participants reported that they had not transported a single patient to the hospital in the four-month period. The majority (25 of 48 respondents) reported transporting one-to-five patients and only four respondents reported transporting more than ten patients. When asked how often a transport card was filled out for patients they transported to the hospital, 29% stated they never filled out a card and only 20% stated that they always filled out a card, suggesting a large amount of uncaptured patient data.

During the study period, 35 individuals were entered into the MKMC trauma registry. Unfortunately, of the eight patients transported to MKMC, none had a matching entry in the registry and the authors were unable to use the registry to determine severity of injury or mortality data for these patients.

Discussion

As demonstrated in previous studies, motorcycle taxi drivers can be successfully trained to provide basic prehospital care in a short time with limited resources.[14,15] All participants demonstrated significant knowledge gain and retention at four months. Most notably, all 50 participants returned for the four-month follow up sessions. This is remarkable given the long travel distance for many and the associated opportunity costs. Nearly all of the trainees felt the training was useful and wanted more training in the future.

The training described here was part of a larger step-wise progression in trauma capacity building at MKMC over several years. It began with training hospital staff at MKMC and in the Masindi region with short courses on assessment and care of the injured patient followed by the establishment of a trauma registry. The trauma registry was successful in providing epidemiological data and identifying several areas for quality improvement. However, the registry was unfunded and always relied on MKMC clinicians to record the data in the paper registry and Prisma researchers to move the data from the paper registry into an electronic database. Despite efforts to train hospital staff and boda drivers on procedures to ensure patient forms were affixed to trauma registry forms, authors were unable to link any of the patients transported to MKMC with trauma registry entries. Only 35 patients were entered into the registry during the study period and study staff could have easily identified the patients in the registry based on the information on the patient form had they been entered into the registry. Several new staff members were hired during the study period and likely were not adequately trained on trauma registry protocols.

While unsuccessful components of research studies and projects such as these are frequently not published or left out of publications, it is important to bring attention to this shortcoming. While much effort is put into segmented and low-cost approaches to decreasing trauma mortality, such as this type of first responder training, less consideration is given to the ability for these programs to prove their worth or leverage into more advanced prehospital systems. Trauma registries are a key component necessary to monitoring and evaluating these initiatives but also require funding for registrars to maintain and analyze the data. Published data on the cost of starting and maintaining trauma registries in LMICs are scarce. A hospital-based trauma registry in Malawi cited low startup costs of $3,196 USD but required an annual budget of $29,697 to maintain.[23] Capturing trauma data at a regional and national level is exponentially more expensive.

Although there is a growing base of literature on layperson Emergency Medical Service (EMS) models, few of these publications provide a cost-analysis for the program or a plan for sustainability. Costs of layperson EMS programs are rarely reported in manuscripts, which limits the analysis of such programs' scalability. The total costs here were estimated at $3,489 USD, or $69 per trainee. This is a very similar cost as a motorcycle taxi prehospital program in rural Chad.[15] However, MKMC operates on a self-sustaining model with a lean budget which makes care accessible and affordable but also means that these additional programs rely on outside donor funding. Trauma and injury care is remarkably under-funded in LMICs, making sustainability and growth of layperson EMS programs tenuous.[24] The difficulties with program evaluation highlighted in this study are likely a more common problem than reported and could have been prevented with a more consistent funding stream.

Limitations

There are several limitations to this study. From the follow up interviews with the boda drivers, it was clear that patient forms were

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Question	Distribution	N (percent)	Median
The training was useful.	1- Strongly Disagree	1 (2.0%)	5
	2- Disagree	0 (0.0%)	
	3- Undecided	0 (0.0%)	
	4- Agree	1 (2.0%)	
	5- Strongly Agree	46 (95.8%)	
I feel prepared to use the skills I learned during the training.	1- Strongly Disagree	1 (2.0%)	5
	2- Disagree	0 (0.0%)	
	3- Undecided	0 (0.0%)	
	4- Agree	2 (4.1%)	
	5- Strongly Agree	45 (93.7%)	
The equipment provided to me is helpful.	1- Strongly Disagree	1 (2.0%)	5
	2- Disagree	0 (0.0%)	
	3- Undecided	0 (0.0%)	
	4- Agree	0 (0.0%)	
	5- Strongly Agree	47 (97.9%)	
I would like to continue training in the future.	1- Strongly Disagree	1 (2.0%)	5
	2- Disagree	0 (0.0%)	
	3- Undecided	0 (0.0%)	
	4- Agree	0 (0.0%)	
	5- Strongly Agree	47 (97.9%)	
How many times do you think you have transported a person to the hospital or clinic since the training?	1- Zero	9 (18.7%)	
	2- 1-5	31 (64.5%)	
	3- 6-10	8 (16.6%)	
	4- >10	0 (0.0%)	
Of the people you have transported, how many have you filled out a transport card for?	All	10 (21.2%)	
	Most	7 (14.8%)	
	About-Half	6 (12.7%)	
	Some	10 (21.2%)	
	None	14 (29.7%)	
How many times do you think you have used your equipment on a person since the training?	Never	9 (18.7%)	
	1-5	31 (64.5%)	
	6-10	7 (14.5%)	
	>10	1 (2.0%)	
What have you used out of your kit (and if so, how many times)?		**Reporting ≥1 Use**	**Total Used**
	Gloves/Mask	39 (81.2%)	146
	Splint (Improvised)	15 (39.4%)	29
	Gauze	35 (72.9%)	106
	Chest Seal	8 (16.6%)	9
	Tourniquet	0 (0.0%)	0
	Tape	33 (68.7%)	104
	Scissors	36 (75.0%)	130

Table 2. Four Month Follow Up Survey

not completed on a significant number of patients transported by the boda drivers during the study period. It is unclear how many of those were injured patients as opposed to medical patients. In addition, the only drop box site was located at MKMC, which required boda drivers to either wait until they were transporting a patient to MKMC to deposit the patient forms or to make a

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Question	Responses
Was there a situation that you came across where you wish you had more training?	• Burn care • Labor/child birth • Seizure management • Snake bites • Multiple-casualty accidents
Is there any equipment that you wish you had?	• Stretchers • Disinfectant • Watch (for recording tourniquet times) • Uniforms or some identifying symbol • Gowns
What reasons prevent you from filling out the transport cards?	• Did not remember • Transport cards designed for trauma patients, but many transports are medical patients • Time consuming, only filled them out for the most serious patients
How could this program be improved?	• More advanced training • Continuous training • Train larger number of boda drivers • Create a trainer of trainers program • Improved and more advanced transport methods
Please explain any specific problems that you had.	• Harassment from police not familiar with the training • Concern over blood exposures • Difficulty reaching patient or hospital due to poor road conditions

Table 3. Semi-Structured Qualitative Interview Responses

special trip. There was also no attempt to track patient outcomes at other hospitals including Masindi Government Hospital where the majority of patients were taken. Also, COVID-19 restrictions and lock downs prevented planned long-term evaluation of the program as well as any additional training.

Conclusions

Motorcycle taxi drivers can be trained to provide basic prehospital care in a short time and a low cost. While there is much enthusiasm for additional training and skill acquisition from this cohort, the sustainability and scalability of such programs is still in question.

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