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RESEARCH ARTICLE

Analysis of a National Trauma Registry in Cameroon: Implications for Prehospital Care Strengthening

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ABSTRACT

Introduction: About 54% of all injury deaths in developing counties are attributable to lack of prehospital care. The study aims to ascertain the current state, determinants, and opportunities for strengthening prehospital care delivery in Cameroon

Methods: From July 2015 to January 2017, Cameroon Trauma Registry was implemented simultaneously at Laquintinie Hospital of Doula, Limbe Regional Hospital, and Catholic Hospital Pouma. Data was subjected to descriptive and inferential analysis. A multiple logistic regression models was built to predict getting prehospital care.

Results: The 7879 patients were mostly male (72.6%), urban dwellers (94%), self-employed (39%) averaging 31.4 years (SD = 15.5). The commonest causes of injury were road traffic crashes (53%), blunt force (15%) and falls (15%). About 669 (9%) patients got prehospital care such as hemostasis (55.3%), fracture immobilization (24%), repositioning (10%), and giving fluid infusions (8%). Friends (35.8%), medical personnel (30.4%), or passersby (20.2%) provided prehospital care. Transport was via taxis (56%), motorcycles (18%), and private vehicles (16%). Predictors of getting prehospital care were injuries at school (perfect predictor), home (OR = 3.10, p <0.0001), public places (OR = 3.79, p <0.0001), or distance ≥ 5 km from the hospital (OR = 4.06, p <0.0001), and rural residence (OR = 4.43, p <0.0001).

Discussion: Prehospital care is typically provided by untrained laypersons in rural and distant areas, and schools. Formal lay provider training may improve prehospital care capacity and access and can drive health system growth.

Conclusion: Formal prehospital trauma systems are limited in Cameroon. Prehospital care development can drive health system growth. Study findings and literature suggest that prehospital trauma care delivery can be improved by leveraging and training lay first-responders to provide prehospital care.

Keywords: Cameroon, Emergency medical services, Global surgery, Injury epidemiology, Low income countries, Prehospital care, Public health, Sub-Saharan Africa, Trauma registry

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INTRODUCTION

Injury causes over six million deaths and 52 million disability-adjusted life years annually.[1,2] In low and middle-income countries (LMICs), injury is a major cause of death and disability. Over 90% of the global burden of injury occurs in LMICs; however, many of resource-poor countries lack the capacity to address the morbidity and mortality associated with injury.[3,4] If LMICs are to adequately address the disproportionately high burden of injury, there is a need to strengthen their health systems to prevent, rapidly detect, respond to, treat, and rehabilitate injured patients.

Prehospital care systems are crucial to delivering timely trauma care and curbing the high burden of injury globally. Timely access to care is a predictor of injury morbidity and mortality.[5–7] About 54% of all injury deaths in LMICs are attributable to lack of prehospital care.[8] Among injured patients studied in India, 30% of on-scene deaths and 80% of deaths that occur within the first hour of injury are due to lack of medical attention. [9,10] Because prehospital trauma care systems reduce mortality rates in LMICs, the World Health Organization (WHO) promotes

the development of basic trauma care systems, including prehospital trauma care, as a solution to the existing morbidity and mortality disparity.[11-13]

In LMICs, prehospital care is a frequently neglected component of the trauma care continuum, remaining largely unavailable.[14,15] The failure to prioritize prehospital care may perpetuate the disparity in injury morbidity and mortality observed in LMICs. Although various successful prehospital care models exist in high income countries (HICs), such models are likely to be inappropriate for LMIC settings.[16,17] Novel or unconventional approaches may be necessary to identify the gaps in prehospital care in LMICs and develop context-appropriate solutions. Such information will inform robust and sensitive prehospital trauma care systems that will address the needs and unique challenges of specific settings.

In Cameroon, data regarding the status of prehospital care in LMICs are scarce, and where available, suggest weak, fragmented, or nonexistent prehospital care systems.[18] Accurate data are needed to identify the strengths, weaknesses, and improvement opportunities in prehospital care systems and to create context-appropriate solutions to challenges. The three-site Cameroon National Trauma Registry was created to improve data collection required to characterize trauma and inform trauma quality improvement and policy interventions.

Using data from this trauma registry, this study aims to ascertain the status of prehospital trauma care, the predictors of access to prehospital care, and early opportunities for strengthening prehospital trauma care in Cameroon. We hypothesize that in Cameroon, an injured patient's tendency to receive prehospital care is determined by their demographic, spatiotemporal, and injury characteristics. The study findings will establish the current state, determinants, and opportunities for strengthening prehospital care delivery in Cameroon. Findings will also serve as a baseline for prehospital care systems development and be used to make policy recommendations.

METHODS

Study Setting

This multicenter study was conducted at the emergency department (ED) of (1) Laquintinie Hospital of Doula (HLD), a large tertiary public hospital in Doula, which is Cameroon's largest city; (2) Limbe Regional Hospital (LRH), a regional referral hospital that has a high trauma volume; and (3) Catholic Hospital Pouma (CHP), which is a mission hospital located on the deadliest road in Cameroon (Yaounde Doula axis road).[19,20] These hospitals have a high trauma patient burden and are located in different administrative regions of Cameroon.

Study Instruments, Data Collection, and Management

We designed the Cameroon National Trauma Registry data collection system (Appendix 1), using the WHO Guidelines for Injury Surveillance and instruments previously used in other LMICs, to capture key variables that reflect demographic, injury, prehospital, and clinical characteristics of injured patients in Cameroon.[21–24] From July 2015 to January 2017, we simultaneously implemented the trauma registry data collection system at the EDs of the three hospitals. Doctors and nurses collected clinical data while research assistants collected non-clinical data regarding the injured patients. These data were entered into the trauma registry forms and then transferred to, stored, and managed using QuesGen, an online data capture and data management software.[25]

Statistical Analysis

In preparation for the data analysis, the data were retrieved from Ques Gen in the form of a Microsoft Excel spreadsheet, cleaned and further analyzed using STATA 12.[26,27] Descriptive analysis was done to estimate the means, medians, and the corresponding confidence intervals. Then we used the two-sample t-test, Wilcoxon-Ranksum test, and chi-square test to evaluate the difference between means of parametric variables, medians of nonparametric variables, and proportions of groups of variables, respectively.

Finally, we developed univariate and multiple logistic regression models to predict the odds of getting prehospital care, or not, based on demographics, injury, spatiotemporal, and pre-hospital characteristics of patients. Findings were reported in tables and charts as means, medians, percentages, odds ratios, and confidence intervals.

Ethical Considerations

Ethical approval was obtained from the Cameroonian National Ethics Committee, the Division of Health Operations Research of the Ministry of Public Health in Cameroon, and the University of California, San Francisco Institutional Review Board. Approval was also obtained from each participating hospital's directorship. As per the request of the ethical review boards, patients or their surrogate decision-makers were approached for informed consent prior to data collection. Those who declined consent for participation were excluded from the study.

RESULTS

Demographic Characteristics

Over the 23-month study period, about 7879 patients, aged from 1 month to 94 years, with a mean age of 31.4 years (SD = 15.5) visited HLD (56%), LRH (38%), and CHP (6%). They were mostly male (72.6%), urban dwellers (94%) from four administrative regions in Cameroon, chiefly Littoral (61%) and Southwest (39%) (Table 1). The majority of the patients were self-employed (39%) and had a secondary (51%) level of education.

Injury Characteristics

More than half of injuries (53%) were due to road traffic injuries, with blunt force injuries (15%) and falls (15%) being the next commonest injury mechanisms. Firearm injuries, poisoning, electrocution, explosion, choking, drowning, and envenomation each occurred in less than 50 patients. These incidents typically occurred on roads or highways (69%), at home (15%), or some other site like a company industrial site (3%) or farm (2%). Seventy percent of injuries (6202) fell into the named injury types used in the trauma registry, while the remaining injuries (30%) were categorized as "other. The top five of the injury types were abrasions (28%), deep lacerations (25%), superficial lacerations (16%), closed fractures (16%), and open fractures (8%).

Prehospital Care Patterns

About 669 (9%) patients received prehospital care (Table1), which took the form of controlling bleeding

Table 1: Summary statistics of the study subjects

Characteristic	*General study population*	*Patients that did not get prehospital care*	*Patients who got prehospital care*	*p-value*
Population, n (%)	7447	6778 (91%)	669 (9%)	
Age, mean ±95% CI (yrs.)	31.4 ± 0.3	31.49 ± 0.4	28.9 ± 0.4	0.01*
Sex n (%)				
Female	2051	1825 (27.0%)	176 (26.9%)	0.76
Male	5445	4810 (73%)	477 (73.1%)	
Highest level of education, n (%)				
No formal education	456	390 (5.8%)	60 (9.0%)	
Primary education	1620	1441 (21.3%)	164 (24.5%)	
Secondary education	3917	3597 (53.1%)	280 (41.9%)	<0.0001*
Tertiary education	808	700 (10.3%)	95 (14.2%)	
Region, n (%)				
Littoral	4633	4148 (61.7%)	349 (53.5%)	
Southwest	2930	2559 (38.0 %)	301 (46.09)	
Central	13	11 (0.2%)	2 (0.3%)	<0.0001*
West	8	7 (0.1%)	1 (0.2%)	
Household area of residence				
Rural, n (%)	285	205 (72%)	80 (28%)	<0.0001*
Urban, n (%)	7132	6548 (92%)	584 (8%)	
Travel time, mean (95% CI)(hr)	7.27 (4.60, 9.75)	6.18 (3.61, 8.74)	16.46 (6.22, 26.71)	0.022*
Distance traveled, median (IQR)	4 (3,5)	4 (3,5)	12 (6,27)	0.0001*
Occupation				
Self-employed	2886	2666 (39.4%)	220 (32.9%)	
Formal employment	1614	1461 (21.6%)	153 (22.9%)	
Student	1085	984 (14.6%)	101 (15.1%)	
Manager	464	429 (6.4%)	35 (5.23%)	
Unemployed (fit to work)	384	359 (5.3%)	25 (3.7%)	<0.0001*
Unemployed (unfit to work)	100	94 (1.4%)	6 (0.9%)	
Retired	160	152 (2.3%)	8 (1.2%)	

Note: Statistical analyses tested differences in means (two-sample t-test), medians (Wilcoxon-ranksum test), and proportions (chi-square, Fisher's exact test) between groups that received prehospital care and those that did not.

*Statistically significant result

(55.3%), immobilizing fractures (24%), placing the patient in the recovery position (10%), and performing intravenous infusion of fluids (8%) (Fig. 1). The use of a backboard (1.8%), spinal immobilization (0.9%), cardiopulmonary resuscitation (CPR) (0.3%), and tranexamic acid (0.1%) were uncommon practices. Prehospital care was typically provided by a friend of the victim (35.8%), medical personnel (30.4%), or a good Samaritan (20.2%) (Fig. 1).

The median distance traveled by patients was 4 km [interquartile range (IQR): (3, 5)]. Urban residents traveled a median of 4 km [IQR: (3, 5)] while rural residents travelled a median of 12 km [IQR: (6, 27)] to access care at the study sites. Taxis (56%), motorcycles (18%), and private vehicles (16%) were the commonest forms of prehospital transport (Fig. 2). Transport via police vehicle (0.7%) and ambulance (0.4%) were rare. On average, it took 16.46 hours [95% CI: (6.16, 26.76) [for patients who received prehospital care and 6.17 hours (95% CI [3.61, 8.74)] for those who did not receive on-scene prehospital care to arrive at the hospital (p = 0.01).

Predictors of Receiving Prehospital Care

The univariate logistic regression analysis (Table 2) showed that not having any formal education (OR = 1.6,

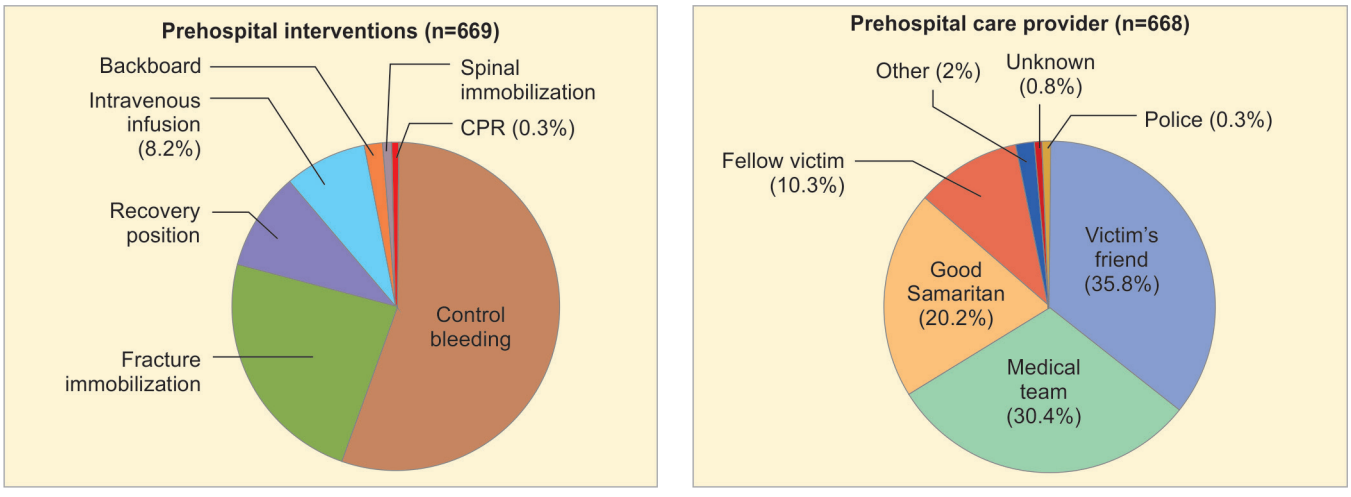

Fig. 1: Distribution of prehospital care interventions and providers

Table 2: Multiple logistic regression analysis of significant predictors of receiving prehospital care

Predictors of receiving prehospital care	*Odds ratio*	*p-value*	*Confidence interval (95%)*
Demographic characteristics			
Age <15 yrs	0.70	0.293	0.36–1.36
No education	1.18	0.619	0.61–2.29
Tertiary education	1.91	0.008*	1.18–3.10
Injury scene			
Home	3.10	<0.0001*	1.70–5.64
Public place	3.79	<0.0001*	2.20–6.53
School	1.00		
Distance from injury scene to hospital			
2nd quartile (3–4 km)	0.30	<0.0001*	0.16–0.57
3rd quartile (4–5 km)	1.20	0.712	0.46–3.12
4th quartile (≥ 5 km)	4.06	<0.0001*	2.54–6.49
Number and mechanism of injury			
Burns	0.27	0.051	0.07–1.01
Penetrating	1.43	0.203	0.82–2.48
Fall	0.86	0.630	0.45–1.61
Number of injuries	1.53	<0.0001*	1.28–1.83
Reference	0.03	<0.0001*	0.02–0.05

*Statistically significant result

Table 3: Univariate logistic regression analysis results showing predictors of receiving prehospital care

Predictors of getting prehospital care	*Odds ratio*	*Confidence interval (95%)*	*p-value*
Demographic features			
Age	0.90	0.83–0.97	0.009*
Sex	1.03	0.86–1.23	0.763
No education	1.61	1.21–2.14	0.001*
Primary education	1.20	0.99–1.44	0.061
Secondary education	0.61	0.52–0.72	<0.0001*
Tertiary education	1.43	1.13–1.80	0.002*
Site of injury			
Home	3.07	2.57–3.66	<0.0001*
Public place	3.01	2.47–3.67	<0.0001*
School	1.83	1.03–3.25	0.039*
In transit	0.24	0.20–0.28	<0.0001*
Other place	0.23	0.06–0.95	0.042*
Distance quartile	1.26	1.18–1.34	<0.0001*
Injury Mechanism			
Burns	2.87	1.83–4.49	<0.0001*
Penetrating injury	2.28	1.87–2.78	<0.0001*
Fall	1.67	1.38–2.04	<0.0001*
Blunt force	0.65	0.50–0.83	0.001*
Road traffic injury	0.48	0.41–0.56	<0.0001*
Other	1.53	0.53 - 4.38	0.431
Number of injuries			
Number of injuries	1.57	1.36–1.81	<0.0001*

*Statistically significant result

p = 0.001) and having tertiary education (OR = 1.43, p = 0.002) were predictors of receiving prehospital care. It also identified injuries that occurred at home (OR = 3.07, p <0.0001), public places (OR = 3.01, p <0.0001) and schools (OR = 1.83, p <0.039) as significant predictors of receiving prehospital care. Rural residents were over four times as likely to receive prehospital care as urban residents (OR = 4.43, p <0.0001). Injuries like burns (OR = 2.87, p <0.0001), penetrating injury (OR = 2.28, p <0.0001), and falls (OR = 1.67, p <0.0001) as well as the number of injuries (OR = 1.57, p <0.0001) were positive predictors of receiving prehospital care.

Multiple logistic regression revealed that being injured at a school was a perfect predictor of receiving prehospital care (Table 3). It also showed that patients who were injured at home (OR = 3.10, p <0.0001), at a public place (OR = 3.79, p <0.0001), or at distance of 5 km or more from the hospital (OR = 4.06, p <0.0001) were also more likely to get prehospital care. On the other hand, patients who had secondary level of education as their highest level of education (OR = 0.77, p = 0.003), suffered blunt force trauma (OR = 0.45, p <0.0001), or were injured while in transit (OR = 0.16, p <0.0001) were unlikely to receive prehospital care (Table 4).

Table 4: Multiple logistic regression analysis of significant predictors of not receiving prehospital care

Predictors of not receiving prehospital care	*Odds ratio*	*Confidence interval (95%)*	*p-value*
Demographic characteristics			
Age	1.00	1.00–1.01	0.536
Secondary education	0.77	0.65–0.91	0.003*
Injury scene			
While in transit	0.16	0.12–0.21	<0.0001*
Other place	0.13	0.03–0.55	0.005*
Injury mechanism			
Road traffic injury	1.50	1.10–2.04	0.01*
Blunt force injury	0.45	0.34–0.60	<0.0001*
Reference	0.30	0.25–0.37	

*Statistically significant result

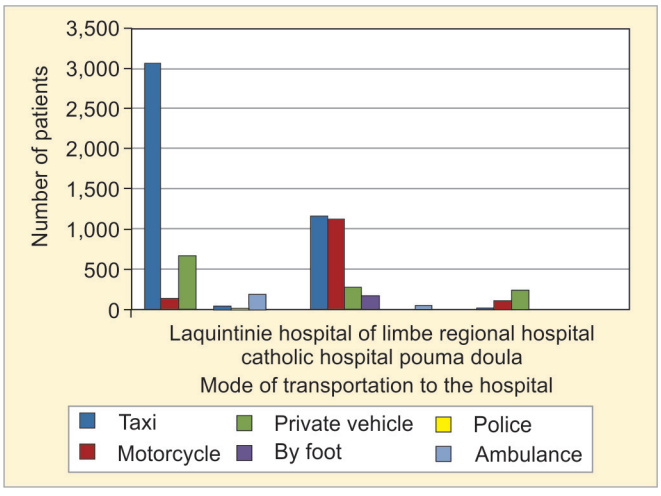

Fig. 2: Modes of prehospital transportation by hospital

DISCUSSION

The Cameroon Trauma Registry captures vital information regarding the prehospital care patterns in Cameroon and can contribute to the growing body of literature about prehospital care in Cameroon. Our findings confirm our hypothesis that, in Cameroon, an injured patient's likelihood of receiving prehospital care is determined by certain demographic, spatiotemporal, and injury characteristics. The demographic, etiologic, and clinical patterns of injury in this study are fairly consistent with existing literature, which shows that in LMICs, males in the third and fourth decades of life and frequent travellers have a higher risk of being injured.[28-30] However, little is known about the prehospital care workforce, interventions, transport, and importantly,

the predictors of prehospital trauma care patterns in Cameroon.[31] These findings bear important implications for emergency medical services (EMS) development, health systems strengthening, public health, and policy in Cameroon.

The location or scene of an injury is a key determinant of prehospital care access. Rural residents and those who were injured at distances of 5 km or more from the study sites were more likely to get prehospital care. Prehospital care providers at locations that are distant or rural may be more likely to deliver prehospital interventions knowing that they are far away from the preferred care site. Conversely, for patients who are in close proximity to the major hospital in urban areas, there may be a higher tendency to adopt a scoop and run approach rather than attempt prehospital care.[32,33]

Most schools have a dispensary where first aid is given to injured patients and/or a designated teacher who is responsible for providing first aid to students before sending them to the hospital. It is perhaps for this reason that being injured in a school proved to be a perfect predictor of receiving prehospital care. This presents an opportunity for formalizing prehospital care at schools. Patients who were injured in public places were more likely to receive care, possibly, because of good Samaritans, who provided prehospital care for a considerable proportion of patients. With an increasing number of injuries, patients were more likely to receive care. Penetrating injuries are associated with a certain sense of urgency that may be related to the visibility of blood or the damaged tissue. Blunt force trauma, on the other hand, may cause potentially life-threatening injuries that are less obvious to untrained prehospital care providers. This may be due to the lack of external manifestations or any sign of an obvious injury.

Groups with low utilization of prehospital care (i.e., patients who are injured while travelling and those with blunt force injuries) are at a higher risk of adverse outcomes and should be prioritized. In this setting, this would entail ensuring that travellers have access to prehospital care if needed. Some countries have non-medical agencies that patrol highways and are tasked with providing first aid and prehospital transportation for victims of road traffic crashes.[34,35] These individuals can be further trained and equipped in an effort to strengthen EMS systems and provide prehospital care for travellers.

Laypersons comprise the majority of the prehospital care workforce in Cameroon. In about 70% of cases, individuals without formal medical training were the prehospital trauma care providers. This pattern is fairly consistent with other developing settings.[36,37] This may be partly related to why basic interventions like bleeding control, fracture immobilization, and repositioning of the patient were more common than techniques like cardiopulmonary resuscitation and spinal immobilization, which would require some level of formal medical training. Further research may be warranted to provide vital information regarding the knowledge, attitudes, skills level, and the practice(s) of these layperson EMS providers.

Improving prehospital trauma care capacity in LMICs would require strengthening the prehospital care workforce.[31] Most LMICs do not have academic institutions with an academic program or curriculum to train EMS providers nor do they have a place within their health system structure or national health plan for EMS systems.[31] Incorporating EMS training into the academic curriculum of universities and integrating the EMS professional into the formal health system requires significant political will and collaboration between the stakeholders in academia; the ministries of health, education, and finance; advocacy groups; and policymakers.

In the absence of formal prehospital care providers, laypersons can be trained as prehospital care providers and integrated into the health system.[37,38] Although lay providers may not be well trained or equipped to provide prehospital care, they can be trained and leveraged to build prehospital care systems in LMICs. Given that road traffic crashes are the leading cause of injury, that patients injured while in transit are unlikely to receive prehospital care, and that taxi drivers are the leading providers of prehospital transport, stakeholders in Cameroon may consider training taxi drivers as prehospital trauma care providers as has been done in similar settings.[38–41] Using taxi drivers to provide prehospital care is also the less expensive option for prehospital transportation as compared with a formal EMS with ambulances.[42] For instance, a taxi-based emergency obstetrics medical transport system in Nigeria had a startup cost of U.S. dollars (USD) 268 and costs clients about USD 5.89 per transport.[42]

The development of prehospital care systems can be used to strengthen health systems in LMICs. Challenges in health care, delivery and health systems have, more recently, triggered the evolution of prehospital care systems towards a public health-focused entity with recent emphasis on emergency preparedness and community-based interventions health surveillance.[43] Having identified injury as a health care priority, governments in LMICs can develop prehospital trauma care systems and leverage that platform to deliver other priority medical services and drive other needed health system improvements. This approach,

described by Sepulveda et al. as the diagonal approach has been suggested as an approach to strengthen health systems in LMICs.[44,45] It is a pragmatic hybrid between the vertical (disease-specific) public health approach and the horizontal approach that focuses on building platforms that strengthen health systems. Essential services like care for emergency obstetric conditions, stroke, cardiac arrest, and other emergencies involving communicable diseases, epidemics, and disasters can be incorporated into a functional prehospital trauma care platform.

Limitations

Although this study achieved its aims, certain limitations were encountered. There might be other factors socioeconomic, cultural factors, geographic factors that influence an individual's likelihood of receiving prehospital care that is unaccounted for in this study. Exploring the role of socioeconomic. Other opportunities for further research include interviewing the layperson providers to understand their practices and ways to leverage them in strengthening prehospital care. About 30% of injuries types were classified as "other" hence this limited out ability to make inferences based on the type of injuries. This has informed a decision to review this variable further and possibly modify the registry to be more sensitive to this information. The authors also acknowledge that the findings of this national trauma registry may not be a generalization to parts of the country where the registry is not in use.

CONCLUSION AND IMPLICATIONS

Formal prehospital trauma care systems in Cameroon are severely limited and expensive.[31] Political will, policies, and resources are required to build EMS systems. The huge burden of trauma and the significant potential of a prehospital care system to reduce morbidity and mortality suggest a potential incentive for stakeholders in LMICs to invest in developing prehospital trauma care systems. The government, prehospital care providers, stakeholders and community members must collaborate to build robust, context-appropriate EMS systems. Local academic institutions will be instrumental in creating a context-appropriate curriculum to train formal and informal EMS providers.

Prehospital care can be used as a driver of health system growth. Our findings suggest that prehospital care in Cameroon mostly occursat places and times that patients are unlikely to access definitive care promptly. Study findings and literature suggest that prehospital trauma care delivery can be improved by leveraging and training lay first-responders (taxi drivers and community members) to provide prehospital care. Courses like the American College of Surgeon's Stop the Bleed and Basic Life Support are potential training options for laypersons these settings.[46,47] There may be a need to adapt such courses to fit the local context. The findings of this study will also serve as baseline data for prehospital care patterns and predictors of prehospital care access in Cameroon. Stakeholders can use the findings in this study to inform policy and prehospital quality improvement interventions. More advocacy and investments are needed to promote prehospital trauma care in Cameroon.

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INVITED COMMENTARY

The authors are to be congratulated for maintaining a trauma database and analyzing the pre-hospital components in Cameroon. It would be important to document how many patients were excluded from the database due to not consenting. It would also be of interest, if possible, to document the mortality of the patients transported by different mechanisms and who received or did not receive the described pre-hospital care. The authors state that the patients who received pre-hospital care took substantially longer to reach the hospitals compared to those who did not receive any pre-hospital care; however, those that received pre-hospital care also were more likely to be more than 5 km away (or rural) compared to those who received no such care. This is confusing and difficult to interpret. It would be of interest to separately analyze the patients from within a 5 Km radius who did and did not receive pre-hospital care and do the same with the group from outside a 5 Km radius. It would assist in understanding if the pre-hospital care was associated with delays in getting to the hospital. As well it would be very useful to compare this to mortality data then to see if there is any correlation between distance, time to hospital and pre-hospital care.

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