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ORIGINAL SCIENTIFIC REPORT

Assessing Trauma Care Capabilities of the Health Centers in Northern Ghana

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Abstract

Introduction Traffic-related injury is a major and increasing cause of global mortality, especially in low- and middle-income countries (LMICs). However, trauma systems, personnel, resources, and infrastructure are frequently insufficient to meet the needs of the population in this at-risk population in LMICs. In addition, these resources are not uniformly distributed, coordinated, nor well described within most countries. Trauma care resources have not previously been characterized in the Northern Region of Ghana.

Methods We performed uniform site evaluations and interviews at 92 hospitals in Northern Ghana. Trauma systems, material resources, and human resources were quantified. Equipment was characterized as available in the Emergency Department (ED), in the hospital only, or unavailable. Hospitals were categorized as primary, district, or referral.

Results Forty-two primary hospitals, 48 district hospitals, 3 regional hospitals, and 1 teaching hospital were surveyed. Over 95 % of hospitals reported having no training or systems for the care of injured patients. Substantial clinical equipment deficits were found at most primary hospitals. In over 90 % of these hospitals, the majority of circulation and monitoring, airway and breathing, and diagnostic imagining resources were not available. Equipment was also frequently unavailable at district and regional hospitals. When available, these resources were infrequently present in the ED.

Conclusions Although resources may be unavoidably constrained, there are substantial opportunities to improve the systematic management of trauma care and improve the education of the medical providers regarding care of injured patients in the region studied.

Introduction

Every year, more than 5 million people die worldwide as a consequence of injury. This represents 9.6 % of all deaths. The death rate from injury is higher than that of HIV/AIDS, tuberculosis, and malaria combined [1]. From 1990 to 2010, the number of deaths due to injury increased 24 %, while deaths due to communicable diseases decreased 17 % [1]. Injury from motor vehicle crash (MVC) is the eighth leading cause of death overall and the most common cause of death for people aged 15–29. In addition, MVC poses a disproportionate burden on lower middle-income

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countries (LMICs) [2]. The 2010 World Health Organization (WHO) report on violence and injury concludes that, although prevention must be the ultimate goal, improvements in trauma care can greatly reduce or minimize the morbidity and mortality due to traffic-related injuries [3].

In a systematic review of trauma system effectiveness in the United States, Mann et al. found a consistent 15–20 % reduction in mortality after system implementation [4]. Nathens et al. reported that states with a regional trauma system have a 9 % lower injury mortality rate than states without [5]. A study by Husum et al. conducted in Cambodia and Iraq demonstrated that trauma systems can also significantly affect trauma mortality in low-income countries [6]. In a review article assessing trauma quality improvement (QI) programs, Juillard et al. found that 34 of 36 studies reported improvements in trauma care after development of trauma QI programs and many reported cost savings from such programs [7].

Previously, Mock et al. [8] published data on trauma care resources on 14 Ghanaian hospitals and Choo et al. [9] published data on 16 emergency surgical services, both in hospitals predominantly in the southern half of Ghana. However, vast differences exist between the northern, inland belt of Ghana and the southern region described in previous studies. These differences stem from geography (lower rainfall and location remote from major industrial centers) and other factors related to the region's history, leading to significant economic inequality. Despite recent economic development in Ghana as a whole, average per capita income in Northern Ghana remains 2–4 times lower than in other regions in the country. Educational inequality also persists between the regions, and medical services are less widely available in the North [10, 11]. The objective of the present study is to assess the trauma resources of the health facilities in Northern Ghana. We sought to perform a systematic, comprehensive assessment of an entire functional section of the country to identify strengths, weaknesses, and opportunities for improvement. We anticipated that there would be substantial material, human resources, and trauma system needs at multiple levels of patient care.

Materials and methods

A cross-sectional study describing trauma care resources in the Northern belt of Ghana (Fig. 1) was conducted from November 2012 to June 2013. A total of 92 health facilities at four levels—primary, district, regional, and teaching—were surveyed, covering all government facilities and all hospitals under the Christian Hospital Association of Ghana (CHAG) in the Brong-Ahafo, Upper East, Upper West, and Northern Regions. Additionally, two district hospitals in Tepa and Ejura of the Ashanti region were assessed because they frequently accept referrals from hospitals in the Brong-Ahafo region. Purely private hospitals and clinics such as the Ghana Community-based Health Planning and Services (CHPS) were excluded from the study. Purely private hospitals were excluded because they generally function independently; this study sought to understand the resources and capabilities of the government health system, which seeks to meet the needs of all Ghanaians. The CHPS clinics were excluded because of their remote location and their function as primary care clinics as opposed to hospital services. Ethical clearance was obtained from the Navrongo Health Research Centre Internal Review Board.

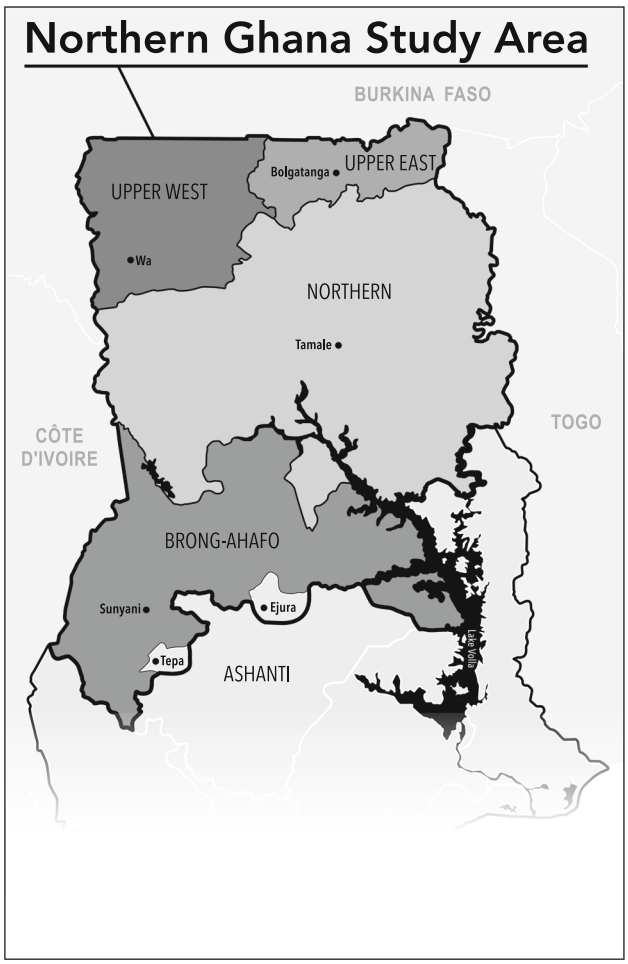

Fig. 1 Map of Northern Ghana study area

Data collection

Data were collected using a questionnaire and checklist to assess equipment needs based on modified WHO Guidelines for Essential Trauma Care [12]. Modifications of the original WHO guidelines included grouping common equipment and excluded diagnostic equipment deemed less

essential in the care for the injured in the region. The modified checklist categorized equipment based on whether it was immediately available in the Emergency Department (ED), available in the hospital, or unavailable. If equipment was present but not functioning, or not available in all required sizes, we classified it as unavailable.

Each assessment visit included personal interviews with the local health personnel of the facility, including medical superintendents, physicians, medical assistants, nurses, directors of nursing, and administrators. Oral consent was obtained from the individuals prior to each interview. Specifically, hospital administrators were asked to provide information about staffing of each facility as well as information regarding injury-related education and trauma systems. Clinicians were interviewed using the modified WHO Guidelines for Essential Trauma Care list and were asked to comment on availability and location of each item on the list. The assessment included also an on-site physical inspection of EDs and medical departments in the presence of the most senior clinician familiar with these areas. The checklist and standardized interviews were used to avoid interviewer bias, and the checklist was not provided in advance to avoid any pre-trial bias.

Data analysis

Simple descriptive statistics were generated to describe resource availability. Formal hypothesis testing was not performed, given that the purpose of the current study was to establish resource availability. Throughout the study, the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines were incorporated [13].

Results

Human resource capabilities of medical providers

At the primary health level (42 hospitals), 10 physicians, 3 specialists, 3 nurse anesthetists, and 39 medical assistants (MAs) provide all medical coverage. Although 3 nurse anesthetists are available, there are no surgeons, anesthesiologists, or emergency medicine specialists at the primary level. At the district level (48 hospitals), 143 doctors, 3 specialists, 1 surgeon, 75 nurse anesthetists, 1 anesthesiologist, and 139 MAs provide all medical coverage. There are no emergency medicine-trained specialists or radiologists at the district hospitals. At the referral hospital level (3 regional and 1 teaching hospital), there are 10 surgeons, 35 specialists, 120 doctors (medical officers), 25 MAs, 1 emergency medicine specialist, 3 anesthesiologists, 27 nurse anesthetists, and 1 radiologist (Table 1).

Table 1 Hospital personnel at government hospitals in the Northern Belt of Ghana (number per facility level)

	Facility level		
	Primary ($n = 42$)	District ($n = 48$)	Referral ($n = 4$)[a]
Medical assistants	39	139	25
Nurse anesthetists	3	75	27
Physicians	10	143	120
Surgeons	0	1	10
Anesthesiologists	0	1	3

[a] Referral facility—teaching hospitals ($n = 1$) + regional hospitals ($n = 3$)

Systems and administrative functions of trauma care

Table 2 lists the current policies, systems, and administrative functions of trauma present at the surveyed hospitals. None of the hospitals surveyed maintain a trauma care oversight committee. Fewer than 5 % of hospitals maintain any administrative or educational processes necessary for systemized trauma care, nor ongoing quality assurance processes.

Physical/equipment resources

The physical resources and equipment for initial resuscitation and care of trauma victims at all levels are summarized in Table 3. With the exception of airway suction devices, intravenous access equipment, and crystalloid for volume resuscitation, the overwhelming majority of primary hospitals lack the basic resources to care for trauma patients. Those resources that are present are usually

Table 2 Training and trauma systems

Does the hospital have	No	Yes
Local trauma guidelines	90 (96 %)	4 (4 %)
Injury manual checklist	93 (99 %)	1 (1 %)
Trauma committee	94 (100 %)	0
Local trauma registry	93 (99 %)	1 (1 %)
System for trauma audit	93 (99 %)	1 (1 %)
Plan for trauma education	93 (99 %)	1 (1 %)
Trauma simulation	92 (98 %)	2 (2 %)
Posters in trauma room	92 (98 %)	2 (2 %)
Defined trauma team	93 (99 %)	1 (2 %)

Table 3 Trauma care resources in Northern Ghana by facility level

Circulation and monitoring	Facility level											
	Primary ($n = 42$)			District ($n = 48$)			Regional ($n = 3$)			Teaching ($n = 1$)		
	ED	Hospital only	Not available	ED	Hospital only	Not available	ED	Hospital only	Not available	ED	Hospital only	Not available
Crystalloids	3 (7 %)	39 (93 %)	0	31 (65 %)	17 (35 %)	0	1 (33 %)	2 (67 %)	0	0	1 (100 %)	0
Colloids	2 (5 %)	1 (2 %)	39 (93 %)	2 (4 %)	19 (40 %)	27 (56 %)	0	1 (33 %)	2 (67 %)	0	0	1 (100 %)
Intravenous access/ infusion equipment	4 (10 %)	34 (80 %)	4 (10 %)	25 (52 %)	20 (42 %)	3 (6 %)	1 (33 %)	2 (67 %)	0	0	1 (100 %)	0
Intraosseous needle	0	1 (2 %)	41 (98 %)	0	5 (10 %)	43 (90 %)	0	0	3 (100 %)	0	0	1 (100 %)
Fluid warmer	0	0	42 (100 %)	1 (2 %)	43 (97 %)	0	0	3 (100 %)	0	0	1 (100 %)	0
Blood transfusion capabilities	1 (2 %)	1 (2 %)	40 (95 %)	9 (19 %)	37 (77 %)	2 (4 %)	0	3 (100 %)	0	0	1 (100 %)	0
Urinary catheters	1 (2 %)	1 (2 %)	40 (95 %)	9 (19 %)	37 (77 %)	2 (4 %)	0	3 (100 %)	0	0	1 (100 %)	0
Diagnostic imaging												
X-ray	0	1 (2 %)	41 (98 %)	0	25 (52 %)	23 (48 %)	0	3 (100 %)	0	0	1 (100 %)	0
Ultrasonography	0	3 (7 %)	39 (93 %)	0	35 (73 %)	13 (27 %)	0	3 (100 %)	0	0	1 (100 %)	0
Airway/breathing resources												
Oxygen supply	1 (2 %)	13 (31 %)	28 (67 %)	18 (38 %)	27 (56 %)	3 (6 %)	2 (67 %)	0	1 (33 %)	0	1 (100 %)	0
Oropharyngeal airway	1 (2 %)	5 (12 %)	36 (86 %)	6 (12.5 %)	36 (75 %)	6 (12.5 %)	0	3 (100 %)	0	1 (100 %)	0	0
vSuction machine	2 (5 %)	23 (55 %)	17 (40 %)	22 (46 %)	25 (52 %)	1 (2 %)	2 (67 %)	1 (33 %)	0	0	1 (100 %)	0
Cricothyrotomy set-surgical or needle	0	1 (2 %)	41 (98 %)	0	7 (15 %)	41 (85 %)	0	0	3 (100 %)	0	1 (100 %)	0
Laryngoscope-adult	0	3 (7 %)	39 (93 %)	0	43 (90 %)	5 (10 %)	0	3 (100 %)	0	0	1 (100 %)	0
Laryngoscope-pediatric	0	3 (7 %)	39 (93 %)	0	44 (92 %)	4 (8 %)	0	3 (100 %)	0	0	1 (100 %)	0
Endotracheal tube-adult	0	3 (7 %)	39 (93 %)	0	44 (92 %)	4 (8 %)	0	3 (100 %)	0	0	1 (100 %)	0
Endotracheal tube-pediatric	1 (2 %)	2 (5 %)	39 (93 %)	0	43 (90 %)	5 (10 %)	0	3 (100 %)	0	0	1 (100 %)	0
Chest tubes-adult	0	1 (2 %)	41 (98 %)	0	14 (29 %)	34 (71 %)	0	1 (33 %)	2 (67 %)	0	1 (100 %)	0
Chest tubes-pediatric	0	1 (2 %)	41 (98 %)	0	14 (29 %)	34 (71 %)	0	1 (33 %)	2 (67 %)	0	1 (100 %)	0
Ventilator	0	1 (2 %)	41 (98 %)	0	37 (77 %)	11 (23 %)	0	3 (100 %)	0	0	1 (100 %)	0

sequestered within the hospital itself and not readily available in the ED or Casualty area where the patients initially present.

At the district and referral hospitals, more resources are routinely available. In addition to the resources listed in Table 3, pressure bags for infusion were present in 13 facilities (7 restricted to the hospital) and infusion pumps were available in only 7 hospitals (6 of which restricted use to the hospital setting). Cardiac monitoring, aside from manual assessment, was severely limited in all settings with only two EDs having access to pulse oximetry (both at the referral/teaching level).

Discussion

This study of the trauma care capabilities of health facilities in the Northern Ghana (Brong-Ahafo, Northern, Upper East and Upper West regions) identified substantial opportunities for resource allocation and trauma system development at all levels of care. An integrated trauma care system with clinical and administrative oversight is almost non-existent within the region. Critical airway and breathing equipment is lacking in most regional hospitals and rarely available in the EDs at all levels. Ventilators are not available in the ED at any hospital and are only present in the operating theaters (district and referral hospitals) or intensive care unit (referral hospitals).

Likewise, there were shortages of monitoring equipment at all levels. Pulse oximetry monitors were present in the EDs in all the referral hospitals, but actually functional in only one facility. These findings are similar to previous studies from South America, Africa, and Asia, [8, 14–16] suggesting that opportunities to learn and improve from previous experience have not been acted upon or have failed ongoing maintenance. Although availability of most equipment increased from primary to district, regional, and teaching hospital, it is notable that, even in teaching hospitals, essential equipment is not available in the ED where an injured patient would first be seen. This finding represents an opportunity to improve care, as some of the equipment present in the hospital could be reallocated to the ED where it could be used for the initial care of these patients.

Health care worker training and continuing education have been found to improve trauma outcomes [17]. Many studies from other LMICs indicate that trauma training programs reduce mortality [6, 18, 19]. An intervention such as providing an Advanced Trauma Life Support (ATLS) course demonstrated similar improvements [20]. Primary and district-level health care facilities in the northern belt of Ghana are frequently managed by medical officers and medical school graduates without additional specialty training, who have limited training in trauma resuscitation and management. Medical assistants, who may not have received any amount of training in trauma care, also provide substantial amounts of patient care at the regional and district levels [21]. Exacerbating these deficiencies, the nearest referral hospital is often a long distance away, and with limited available ambulance transport, the lack of required trauma care education for these providers is highly detrimental to patient outcomes. At this time, there are no trauma care education requirements, even though severe trauma is quite common and the nearest referral hospital is a far distance away [22].

Although there is an established nomenclature for hospitals and health centers (primary, district, and referral centers), this does not necessarily reflect the trauma capacities of each hospital. In addition, available resources and care capacity are not uniformly understood between facilities and not universally discussed regarding patient care referral decisions. South Africa recently published a new set of classification criteria modeled off the WHO Essential Trauma Care guidelines; ranging from a Level I to Level IV (major trauma center, urban trauma center, and primary healthcare center) [23]. Establishing a similar basis for classification (and the personnel and consumable resources needed for such determination) would represent a substantial step forward in the integrated trauma care process and likely impact outcomes.

Such criteria can also provide a standard for each hospital's ongoing maintenance respective to their level of designation. However, using these criteria, most of the hospitals and health centers in this study would not qualify as a trauma center regardless of level. The Tamale Teaching Hospital, the hospital with greatest trauma capacity in our study area, would qualify as a Level III trauma center (meant for community hospitals) with only a few other facilities that would qualify as a Level IV (meant for primary health centers) center. Therefore, given the relative designation failure under these criteria, consideration should be given to develop a further modified set of criteria using the current functional state of trauma care capacity—while concurrently identifying a stepwise development strategy for each site to reach its appropriate level of designation. As the trauma care capacities are improved, this set of criteria should be refined intermittently until it matches appropriate LMIC international standards—an approach that would be easily generalizable for other settings.

Once the trauma levels have been established, public health officials should work with individual hospital administrators to determine staffing, resource, and trauma system management plans based on case type, severity, patient status, and the availability of trauma-capable referral centers. System-based protocols can then be established that can guide each hospital and emergency

first responders in terms of which injuries to treat locally versus transfer to regional hospitals if resources are available. In addition, concurrent development of post trauma management resources, including physiotherapy, rehabilitation, prosthetics, and psychology, should be considered [24].

Limitations

This study is based on a 94-site-specific trauma system resource assessment. While it identified the current available resources and providers, it may well underestimate the need, as information on the number and severity of trauma presentations is uncertain. In addition, in the absence of a robust prehospital trauma system, including layperson first-responder training programs [25] and interfacility transfer processes, the overall impact may not be initially realized as many patients may never survive to present to or be transferred from these facilities. This study also does not take into account the infrastructural limitations at and between each site.

Conclusion

Although resources may be unavoidably constrained, there are substantial opportunities to improve the systematic management of trauma care and improve the education of the medical providers in the region studied and in all LMICs. It is time to use existing knowledge to bridge the trauma care gaps and garner support of the international community through educational collaboration, system development guidance, and further research.

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