



ORIGINAL ARTICLE

The preventability of trauma-related death at a tertiary hospital in Ghana: a multidisciplinary panel review approach



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ABSTRACT

Introduction: The purpose of the study was to determine the preventable trauma-related death rate (PDR) at Komfo Anokye Teaching Hospital in Kumasi, Ghana three years after initiation of an Emergency Medicine (EM) residency

Method: This was a retrospective, cross-sectional study. A multidisciplinary panel of physicians completed a structured implicit review of clinical data for trauma patients who died during the period 2011 to 2012. The panel judged the preventability of each death and the nature of inappropriate care. Categories were definitely preventable (DP), possibly preventable (PP), and not preventable (NP).

Results: 1) The total number of cases was forty-five; 36 cases had adequate data for review. Subjects were predominately male; road traffic injury (RTI) was the leading mechanism of injury. Four cases (11.1%) were DP, 14 cases (38.9%) were PP and 18 (50%) were NP. Hemorrhage was the leading cause of death (39%). Among DP/PP deaths there were 37 instances of inappropriate care. Delay in surgical intervention was the predominate event (50%). 2) The PDR for this study was 50% (0.95 CI, 33.7%–66.3%)

Conclusion: Fifty percent of trauma deaths were DP/PP. Multiple episodes of varying types of inappropriate care occurred. More efficient surgical evaluation and appropriate treatment of hemorrhage could reduce trauma mortality. Large amounts of missing and incomplete clinical data suggest considerable selection bias. A major implication of this study is the importance of having a robust, prospective trauma registry to collect clinical information to increase the number of cases for review.

Introduction

Injury results in 5.8 million deaths worldwide every year which is 32% more than HIV, malaria, and tuberculosis combined [1]. Africa has the highest mortality rate from motor vehicle crashes (32.2 per 100,000 population), nearly double that of North America [1]. A major contributor to the disparity in sub-Saharan Africa is the lack of an organized emergency medical care system [2]. Fundamental to any emergency medical system is a hospital-based emergency department staffed around the clock with trained physicians and nurses [3]. However, the optimal strategy for creating hospital-based emergency departments in sub-Saharan Africa and the impact on patient outcomes has yet to be determined.

Ghana is a sub-Saharan African nation with a population of 300 million and like most low- to middle-income countries, faces a

traumatic injury epidemic [1,4]. A previous study by London [2] notes that in Ghana, patients arriving at a tertiary healthcare facility experience significant delays and increased mortality compared with similarly injured patients in the United States. London [2] speculates that improvements in several areas, including initial resuscitation of trauma patients, could improve trauma outcomes. In 2009, a new Emergency Department opened in the city of Kumasi at the Komfo Anokye Teaching Hospital (KATH). At that time, training of physicians and nurses in the specialty of Emergency Medicine began.

The effectiveness of interventions to decrease trauma deaths is often difficult to quantify [3]. One proven methodology, performing a review of deaths using a multi-disciplinary panel, assesses preventability given the utilization of appropriate medical care [5,6]. A paper by Yeboah [7], reported that 60% of trauma deaths during a 5-month period in 2006–2007 occurring at KATH were classified as definitely preventable

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or possibly preventable using the WHO framework [5]. The authors concluded these deaths may have been preventable by decreasing pre-hospital delays and increasing the timeliness of care and resuscitation in the emergency department [7].

The aim of this paper is to determine the frequency of preventable trauma deaths and nature of inappropriate care since the initiation of the emergency medicine training program in 2008.

Methods

This is a retrospective descriptive cross-sectional study conducted from 2 January 2011 to 31 December 2012 at KATH in Kumasi, Ghana (population 4 million) [4]. KATH is a 1000 bed tertiary facility for the Ashanti region with a National Accident and Emergency Center, the only one of its kind in Ghana. KATH provides trauma care for approximately 14,000 patients per year. In 2009, the emergency department (ED) opened and a 3-year emergency medicine training program was introduced with the first class of specialists graduating in 2012.

Emergency medicine residents are the first to evaluate and treat trauma patients in the ED. At KATH, attending emergency medicine physicians, present in the ED 24 h per day, supervise the residents. Triage of patients utilizes the South African Triage Score (SATS) [8,9] and patients receive treatment based on injury severity. Evaluation and resuscitation by an emergency physician is often followed by a medical or surgical consultation, and/or admission when necessary. Severely injured patients are transported to the operating theater or admitted to the intensive care unit (ICU) after initial stabilization in the ED.

Ghana has a National Ambulance Service (NAS) operating in all regions of the country. The NAS operations are centralized with training of emergency medical technicians occurring at their national training center. At the time of the study, NAS primarily provided inter-facility transfers. Thus, the majority of trauma patients arrive at KATH using a mix of public and private transportation [10].

Our study population were patients arriving at KATH with a traumatic mechanism of injury whose outcome was death. All ages were included. Patients excluded from the study were those pronounced dead on arrival (DOA) and those without evaluation and treatment in the ED. In addition, injury deaths with the following mechanisms were excluded from the study: drowning, suffocation, inhalation, poisoning including drug overdoses, and suicide by hanging.

We reviewed paper records in the Pathology Department to identify cases matching the name of the patient and date of death with ED admission date. The patient's ED registration number was provided to the medical records staff and using the registration number, we randomly selected 50 patients from each year, 2007–2012. Unfortunately, the medical records department could not find physical records for patients from 2 January 2007 to 1 January 2011. We then broadened the search of the ED admissions data (paper) for patients that either had similar names or presented on similar dates as the patients identified in the pathology records, allowing us to capture names that were misspelled.

Data collected included age, gender, mechanism of injury and whether the person was a driver, passenger or pedestrian involved in a motor vehicle or motorcycle crash. Other data collected included temporal measures including time from the acute incident until presentation at KATH; timing of procedures, interventions and consults; total time in the ED prior to admission or death; and place of death at KATH. From the paper chart obtained from medical records, notation included the types of injuries sustained, presenting vital signs, Glasgow Coma Score (GCS), and hospital course.

Determining the preventability of death and the appropriateness of care occurred using a multidisciplinary panel of health care providers. The panel used a structured implicit review process adapted by Maio [11]. Methods for the panel death review were similar to those used by the World Health Organization [5]. The chair of the committee, a

dentist, had been involved in a similar review process previously. The other members of the 8-person panel included a neurosurgeon, two trauma surgeons, one general surgeon, an anesthesiologist, a pathologist, and an emergency physician. All panel members attended an initial training session concerning the implicit review process, including the procedure for finalizing their judgments regarding preventability. At the session, panel members reviewed several sample cases not involving KATH patients. This provided an opportunity for questions, discussion and clarification of panel member concerns.

During the actual panel review process, each case was randomly assigned to a panelist who functioned as the lead reviewer. The first author (RAO) and two emergency medicine physicians extracted the data and wrote the case summaries. The lead reviewer examined the entire medical record and the other panel members reviewed the case summary. The entire medical chart was also available at the meetings. Upon reviewing the cases, the panel utilized standard of care at KATH for the injured patient considering the limitations of the available local resources.

Next, the panel leader obtained a group consensus on the preventability of death. The options presented were definitely preventable (DP), possibly preventable (PP), and not preventable (NP). When mortality could have been avoided by the timely implementation of standard practice, it was termed DP. PP was defined as mortality that could have been possibly avoided, and NP was defined as mortality that was unavoidable. If there was insufficient information from the patient record to reach a conclusion, the death was ruled indeterminate. Each panelist reviewed patient presentation, hospital course and autopsy results, if available. A group discussion regarding the preventability of death followed until consensus was reached and documented.

Following this step, the panelists addressed the appropriateness of care the patient received. Options were optimal, suboptimal or indeterminate. During this phase, the panel reviewed the hospital course in detail focusing on actions taken, investigations obtained, interventions implemented and medications delivered. For this review, panelists took into consideration the timing of patient care. The determination of appropriateness was based on whether the expert panel agreed with the medical and surgical decisions, and the interventions. In cases where the patient was deemed to have suboptimal care, the panel identified the point in care where this occurred. The panel evaluated patient airway management, hemorrhage control, chest injury management, fluid resuscitation, and delays in medical and/or surgical consultation, and imaging studies. They also determined whether the documentation of care was appropriate.

The panel was then asked to identify the physical location where suboptimal care occurred. Choices included the prehospital setting, the initial phase of hospital care in the ED, the operating theater, the intensive care unit (ICU), or the inpatient ward. Panelists also commented on whether a system failure led to patient mortality. The definition of system failure was mortality attributable to the underdevelopment of systems of care, including unavailable resources critical to appropriate care of the acutely injured patient.

For each death, the panel determined whether more than one episode of inappropriate care occurred. Further, an episode of inappropriate care could involve more than one location. For example, an episode of inappropriate care could have occurred in both the ED and ICU due to inappropriate airway management in both stages of care.

Based on the KATH ED log, we anticipated approximately 600 trauma deaths per year. Due to resource constraints, we could only conduct a total of approximately 50 panel reviews. We planned to take a random sample of 25 patients from each year of the study period.

For categorical data, analysis included frequencies to describe the data. Continuous data were described using means and standard deviations. A 0.95 CI was calculated for the preventable death rate (PDR).

The study was reviewed by the IRB at Kwame Nkrumah University for Science and Technology (KNUST).

Results

The number of cases with available medical records was 45 for the period 2 January 2011–31 December 2012. Of these, 36 cases (80.0%) had adequate data to compile a case abstract. Among the 36 cases, 4 (11.1%) were DP, 14 (38.9%) were PP, and 18 (50.0%) were NP. Twenty-four deaths (67.6%) were male (Tables 1 and 2).

The mechanism of injury was predominantly road traffic crashes ($n = 20$). Other mechanisms of injury were burns (6), falls (6), struck by falling object (1) and unknown (3). Table 3 shows preventability categorized by the primary cause of death. Death due to hemorrhage ($n = 7$) was the leading cause of death for DP and PP, followed by traumatic brain injury ($n = 6$), the second leading cause of death for DP and PP.

Table 4 illustrates the number of cases having one or more episodes of inappropriate care by preventability status. For DP and PP, the top two types of inappropriate care were delay in surgical intervention ($n = 9$), and airway management ($n = 8$).

Table 5 illustrates the type of inappropriate care (e.g., airway management, delay in surgical intervention) by the location of inappropriate care (e.g., pre-hospital, first hospital) for deaths classified as DP or PP.

There was a total of 21 cases with inadequate documentation of care. Distribution by preventability status (DP, PP, NP) was 2, 12 and 9, respectively. There were 26 cases of system failure with a distribution of 2, 11 and 13, respectively. For DP/PP cases, an inappropriate episode was most likely to occur in the ED. Airway management was the most frequent type of inappropriate care for DP/PP. The PDR for this study was 50% (0.95 CI, 33.7%–66.3%).

Discussion

Our findings are important for several reasons. First, they underscore the need for improved trauma care in Ghana. Fifty percent of the deaths examined could have been prevented by delivering the standard of care in a timely manner. Secondly, the comparison of the PDR in this study to one conducted 10 years ago by Yeboah [7], illustrates that DP/PP deaths remain a substantial problem at KATH. This finding underscores the challenge for improving trauma care in Ghana and specifically, as well as implementing an EM residency to improve trauma care at KATH is not yet optimal. Studies of preventable trauma deaths in the US, UK and Europe found DP death rates ranging from 2 to 11 percent and PP death rates of 10 to 32 percent [7]. Studies of preventable trauma mortality from other low- to middle-income countries report percentages of the combined DP/PP deaths ranging from 22 to 72% [7]. These are similar to PDRs from older studies in the USA, UK and Europe ranging from 7 to 73% [11–22].

In our study, the most common cause of death overall was hemorrhage and among the DP/PP cases, the major cause of death was hemorrhage. In Yeboah's study, TBI was the most common and major cause of death. More episodes of inappropriate care were noted compared to the Yeboah study. However, in their study, panel members were asked to identify one important episode of inappropriate care for each case. In our study, panel members identified episodes of

Table 1
Age groups by preventability status.

	Definitely preventable	Possibly preventable	Not preventable
0–14 years	0 (0)	4 (28.6)	4 (22.2)
15–24 years	0 (0)	1 (7.1)	1 (5.6)
25–34 years	0 (0)	2 (14.3)	4 (22.2)
35–49 years	1 (25.0)	4 (28.6)	3 (16.7)
50–64 years	2 (50.0)	3 (21.4)	4 (22.2)
65+ years	1 (25.0)	0 (0)	2 (11.1)
	4 (100.0)	14 (100.0)	18 (100.0)

Table 2
Mean and median age at death by preventability status.

	Definitely preventable	Possibly preventable	Not preventable
Overall			
Median age	55	34.5	36.5
Age range	49–69.5	12–48	22–59

Table 3
Cause of death by preventability status.

	Definitely preventable	Possibly preventable	Not preventable
Hemorrhage	1 (25.0)	6 (42.9)	8 (44.4)
Multi-organ failure	1 (25.0)	0	2 (11.1)
Respiratory arrest	1 (25.0)	1 (7.1)	0
Sepsis	0	1 (7.1)	1 (5.6)
Traumatic brain injury	1 (25.0)	5 (35.7)	7 (38.9)
Unclear Etiology	0	1 (7.1)	0 (0)
Total	4 (100.0)	14 (100.0)	18 (100.0)

inappropriate care from a total of 7 possible choices, based on a study from the United States utilizing a structured review process [11]. In addition, our study also considered deficiencies in documentation and system failure. Like Yeboah's study, most episodes of inappropriate care occurred in the area where emergency resuscitation occurred.

The overwhelming majority of inappropriate care episodes was airway management. This was not a category analyzed in Yeboah's study, although it has been noted in prior preventable death studies [11]. When Yeboah conducted his study, advanced airway management delivered by physicians in the ED was not considered a standard of care. Comparing the PDR for the present study with Yeboah's, there is only a 10% difference (50% vs. 60%). However, the 0.95 CI for our PDR includes 60%. Thus, random variation cannot be ruled out as the reason for this difference.

Despite the many differences between the two studies, 1) the PDRs were very similar, 2) the primary cause of death was very similar, and 3) the location of the most frequent episodes of inappropriate care was the ED. Although both studies identified the frequency and nature of preventable trauma deaths and the episode of inappropriate care, neither study addressed why inappropriate occurred or the type and/or specialty of the provider associated with inappropriate care. Identifying why inappropriate trauma care occurs in low resource settings is particularly complex. One needs to consider not only errors in recognition or judgments as causes, but also the lack of resources. A recent study by Stewart et al. [23] evaluated trauma resources in Ghana. General areas of concern noted were: available resources, operating condition of the resources, and the availability of personnel knowledgeable in using or operating the resources.

Another issue to consider is the ability of the patient or patient's family to pay for care and/or a specific intervention. In Ghana and other low- to middle-income countries, some diagnostic tools for acute trauma care such as CTs or X-rays are not utilized unless reimbursement is guaranteed. Delays in some surgical/medical interventions (e.g., IV antibiotics for an open fracture) may also occur. Despite the skill level of the providers, the ability to overcome these reimbursement issues is limited.

Further, among identified cases, there was a lack of adequate information to classify preventability. To address this deficiency, a trauma registry has been implemented, modified from the American College of Surgeons Committee on Trauma (ACS/COT) national trauma data bank. This registry will facilitate ongoing trauma care evaluation on a regular basis in the future. The growing interest in trauma care and trauma panel reviews among KATH clinicians, stimulated by Yeboah's work and development of the EM residency, is encouraging.

Table 4
Type of inappropriate care episode^a by preventability status.

	Definitely preventable	Possibly preventable	Not preventable
Delay in surgical intervention	3 (23.1)	6 (10.9)	4 (6.5)
Airway management	1 (7.7)	7 (12.7)	13 (21.0)
Delay in medical intervention	1 (7.7)	6 (10.9)	6 (9.7)
Inappropriate imaging	0 (0)	7 (12.7)	10 (16.1)
Fluid resuscitation	2 (15.4)	4 (7.3)	3 (4.8)
Hemorrhage control	1 (7.7)	2 (3.6)	1 (1.6)
Chest injury management	1 (7.7)	0 (0)	3 (4.8)
Total	9 (100.0)	32 (100.0)	40 (100.0)

^a Multiple episodes of inappropriate care could occur for the same patient

Table 5
Episode of inappropriate care^a by location for deaths classified as DP/PP.

	Pre-hosp ^b	First hospital	ED	Operating theater	ICU	Ward
Airway management	2 (40.0)	8 (33.3)	12 (31.6)	0 (0)	2 (40.0)	0 (0)
Inappropriate imaging	1 (20.0)	6 (25.0)	9 (23.7)	0 (0)	2 (40.0)	0 (0)
Delay in medical intervention	1 (20.0)	3 (12.5)	6 (15.8)	0 (0)	1 (20.0)	0 (0)
Delay in surgical intervention	1 (20.0)	3 (12.5)	4 (10.5)	0 (0)	0 (0)	0 (0)
Chest injury management	0 (0)	2 (8.3)	3 (7.9)	0 (0)	0 (0)	0 (0)
Fluid resuscitation	0 (0)	1 (4.2)	3 (7.9)	1 (100.0)	0 (0)	0 (0)
Hemorrhage control	0 (0)	1 (4.2)	1 (2.6)	0 (0)	0 (0)	0 (0)
Total	5 (100.0)	24 (100.0)	38 (100.0)	1 (100.0)	5 (100.0)	0 (0)

^a One or more episodes

^b Pre-hospital

A major limiting factor noted while conducting this study was documentation. Often there was no documented medical decision making, so we could not determine for example whether a patient with a chart documented GCS of less than 8 was not intubated due to lack of equipment or knowledge. The paper records, sparse handwritten notes, lack of a hospital-wide unique patient identifier, poorly organized filing systems and suboptimal storage conditions made it difficult to locate and review previous patient encounters. Where the records were available, they were often noted to be grossly incomplete. Therefore, this study is open to substantial selection bias and mis-classification bias.

Conclusion

Due to the inadequacy of the clinical record system, only a small number of deaths were reviewed by the panel in comparison to the overall number of traumatic injury deaths that occurred during the study period. Half of the trauma deaths were DP/PP and of these, multiple episodes of various types of inappropriate care occurred among these deaths and in all settings. Since 2007, the DP/PP death rate at KATH remains substantial. Correcting delays in surgical care and inappropriate treatment of hemorrhage may improve trauma outcomes. Also, improved attention to clinical documentation, appropriate recordkeeping practices, and robust data collection with in-depth analysis would aid further studies in determining the preventability of death. A major implication of this study is the importance of having a robust, prospective, electronic trauma registry that collects detailed clinical information.

Dissemination of results

Result from this study were shared with the departments of Emergency medicine, Trauma surgery, General surgery and Anesthesia at Komfo Anokye Teaching Hospital.

Author contribution

Authors contributed as follows to the conception or design of the work; the acquisition, analysis, or interpretation of data for the work;

and drafting the work or revising it critically for important intellectual content: RAO contributed 45%; DO-K, SEMF-A, KE, HY and RFM contributed 10% each; and BA contributed 5%.

All authors approved the version to be published and agreed to be accountable for all aspects of the work.

Conflict of interest

Dr Rockefeller Oteng is an editor of the African Journal of Emergency Medicine. Dr Oteng was not involved in the editorial workflow for this manuscript. The African Journal of Emergency Medicine applies a double blinded process for all manuscript peer reviews. The authors declared no further conflict of interest.

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