

Minimizing Preventable Trauma Deaths in a Limited-Resource Setting: A Test-Case of a Multidisciplinary Panel Review Approach at the Komfo Anokye Teaching Hospital in Ghana

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Abstract

Objective Our objectives were to determine the proportion of preventable trauma deaths at a large trauma hospital in Kumasi, Ghana, and to identify opportunities for the improvement of trauma care.

Methods A multidisciplinary panel of experts evaluated pre-hospital, hospital, and postmortem data of consecutive trauma patients who died over a 5-month period in 2006–2007 at the Komfo Anokye Teaching Hospital. The panel judged the preventability of each death. For preventable and potentially preventable deaths, deficiencies in care that contributed to their deaths were identified.

Results The panel reviewed 231 trauma deaths. Of these, 84 charts had sufficient information to review preventable factors. The panel determined that 23 % of trauma deaths were definitely preventable, 37 % were potentially preventable, and 40 % were not preventable. One main deficiency in care was identified for each of the 50 definitely preventable and potentially preventable deaths. The most common deficiencies were pre-hospital delays (44 % of the 50 deficiencies), delay in treatment (32 %), and inadequate

fluid resuscitation (22 %). Among the 19 definitely preventable deaths, the most common cause of death was hemorrhage (47 %), and the most common deficiencies were inadequate fluid resuscitation (37 % of deficiencies in this group) and pre-hospital delay (37 %).

Conclusions A high proportion of trauma fatalities might have been preventable by decreasing pre-hospital delays, adequate resuscitation in hospital, and earlier initiation of care, including definitive surgical management. The study also showed that preventable death panel reviews are a feasible and useful quality improvement method in the study setting.

Introduction

In both developing and developed countries, injuries claim a heavy toll in terms of morbidity and mortality, resulting in 11 % of disability-adjusted life-years lost globally [1, 2]. In 2010, over 5 million people died from injury, an additional 1 million deaths relative to 2 decades earlier [3]. A significant proportion of trauma deaths in low- and middle-income countries (LMIC) may be prevented by feasible and affordable improvements in trauma care [4–6].

To promote these improvements, there is a need for improved trauma care systems, including trauma quality improvement programs to monitor rates of complications and preventable deaths. Medically preventable deaths may result from a variety of factors, including errors in diagnosis, delays in emergency procedures such as maneuvers to relieve airway obstruction, and delays in time to start of emergency surgery.

One of the established approaches to monitoring trauma care is to conduct a multi-disciplinary panel review of institutional trauma deaths [7]. A panel of local experts is best positioned to determine which deaths might have been preventable given local resources and the local care

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environment. Assessments of preventable mortality identify problems to be corrected, such as prolonged pre-hospital transport times and inadequate hospital staffing. Previous preventable death studies have served as a catalyst to improve care [8–12].

Despite their cost effectiveness and other benefits, preventable death reviews and related trauma quality improvement programs have been infrequently utilized in LMICs. The purpose of this study was to field test the preventable death panel review approach and to determine the proportion of preventable trauma deaths at a large hospital in Kumasi, Ghana, and identify opportunities for improving trauma care.

Methods

Setting

This study was undertaken at the Komfo Anokye Teaching Hospital (KATH) in Kumasi, Ghana in 2006–2007 before a dedicated accident and emergency center was established at the hospital. KATH has 1,000 beds and is the principal referral hospital for the northern two-thirds of Ghana (500 × 500 km). Injured patients were initially assessed by junior surgery residents in the casualty ward, where resources are extremely limited. If urgent resuscitation is needed, patients are triaged to a multipurpose intensive care unit (casualty ICU), which is adjacent to both the casualty ward and the emergency operating room. In addition to serving as the ward for the most critically ill surgical patients in the hospital and as the de facto trauma resuscitation room, the ICU also serves as the recovery room for the emergency operating room. The city of Kumasi (population 1,000,000) has a rudimentary emergency medical service (EMS). However, the majority of severely ill and injured individuals continue to be brought to the hospital by relatives, using a mixture of private and public transportation.

Data gathering

Medical records of all patients who died from trauma at KATH during a 5-month period, from 1 October 2006 to 1 March 2007 were abstracted. Trained research assistants abstracted data using a standardized checklist, and entered de-identified data into a computerized abstract form with study numbers. Medical chart data were supplemented by autopsy reports. Pre-hospital deaths resulting from suicide were excluded, as they were not considered survivable. Also excluded were deaths due to burns, suffocation, inhalation, hanging, drowning, poisoning, and drug overdose. Information was collected on demographic characteristics,

mechanism of injury, pre-hospital time (estimated time elapsed between the injury event and hospital arrival), initial vital signs, diagnostic tests, treatment rendered, location of death (pre-hospital or location in hospital), and time elapsed between hospital arrival and death. Additionally, primary cause of death as determined by a pathologist was recorded. A paragraph-length abstract was prepared on each case.

Preventable death panel reviews

Standard methods for preventable death panel reviews were used, as described by the World Health Organization (WHO) [7]. A panel of eight experts in trauma care was formed, including surgeons, emergency physicians, senior nurses from the emergency department, pathologists, and others as deemed appropriate. Members of the group were knowledgeable about available resources and standards of trauma care at KATH. All panel members attended an initial orientation session during which the review process was explained, including the nature of the judgments the members were to make.

Anonymous abstracts of each case were provided to panel members in advance of the meeting. Each member received 10–12 case summaries to review in advance, two as primary reviewer. Cases were reviewed by the full panel. During panel review, the abstracts and data abstraction sheets, but not full records, were available for the panel to read. Panel members were blinded as to the name and other identifying information of the patient. The primary reviewer of each case led the discussion of that case. Trauma care was evaluated for appropriateness according to accepted guidelines at KATH, and corrective actions for preventing similar occurrence were recommended. A vote (simple majority) was taken as to whether the deaths were preventable, potentially preventable, or non-preventable.

Definitions for preventable, potentially preventable, or non-preventable were as per WHO guidelines. In brief, a trauma death was preventable if (i) the injuries were considered survivable; (ii) death could have been prevented if appropriate steps had been taken; and (iii) frank deviations from standard of care, directly or indirectly, caused the patient's death. Potentially preventable deaths were those (i) for which injuries were severe, but survivable; (ii) that could potentially have been prevented if appropriate steps had been taken; (iii) for which management was generally appropriate, but with some deviations from the standard of care that may, directly or indirectly, have been implicated in the patient's death. Non-preventable deaths were those for which: (i) injuries were non-survivable even with optimal care; (ii) management was appropriate according to accepted standards; (iii) any co-morbid factors the patient may have had were major contributors to death [7].

The panel also determined whether there had been deficiencies in care. Deficiencies were categorized as to type: pre-hospital delay, delay in treatment, inadequate fluid resuscitation, or error in diagnosis. The locations of deficiencies in care were classified as pre-hospital, casualty ward, casualty ICU, operating room, or surgical ward. In cases where multiple deficiencies occurred, only the most grievous deficiency was considered.

The study was approved by the Institutional Review Boards of the Kwame Nkrumah University of Science and Technology and the University of Washington.

Results

Over the 5-month inclusion period, 231 trauma deaths occurred at KATH. Of these, 147 cases were excluded on account of inadequate information or deficiency in documentation. All of these deaths occurred in the pre-hospital setting. For the 84 cases for which there was sufficient information to enable determination of preventability of death, characteristics are summarized in Table 1. Most individuals were young adult males, injured in motor vehicle crashes. There were considerable pre-hospital delays. As befitting its role as the location where the most seriously ill surgical patients were cared for (including for initial resuscitation), most deaths occurred on the casualty ICU. The most common cause of death was central nervous system (CNS) injury (62 %), followed by hemorrhage (21 %) and airway obstruction (7 %).

Of the 84 deaths reviewed, 19 (23 %) were judged definitely preventable, 31 (37 %) probably preventable, and 34 (40 %) as non-preventable. Most (71 %) non-preventable deaths occurred within the first 24 h after arrival compared with definitely and possibly preventable deaths (48 %; $p = 0.04$). Most (82 %) non-preventable deaths occurred in patients with Glasgow Coma Scale (GCS) ≤ 8 (82 %) compared with definitely and possibly preventable deaths (43 %, $p = 0.004$).

A total of 50 deficiencies in care were documented (Table 2). The most common of these deficiencies were pre-hospital delays (44 % of the 50 deficiencies), followed by delay in treatment (32 %) and inadequate fluid resuscitation (22 %). Inadequate fluid resuscitation and pre-hospital delay were the leading deficiencies associated with definitely preventable deaths, each accounting for 37 % of deficiencies in that group. Pre-hospital delay was the leading deficiency associated with potentially preventable deaths, accounting for 45 % of deficiencies in that group.

Most deficiencies in care occurred in the pre-hospital setting (54 %) or the casualty ICU (40 %) (Table 2). Pre-hospital deficiencies included delay in inter-facility transfer, delay in seeking hospital care, and delay in transporting the injured from the site of injury to hospital.

Table 1 Distribution of 84 trauma deaths by gender, age, mechanism of injury, pre-hospital delays, arrival GCS score, location of death, and time of death

Characteristic	No	% ^a
Gender		
Male	68	81
Female	16	19
Age (years)		
0–5	3	4
6–18	4	5
19–49	54	74
≥ 50	12	16
Mechanism of injury		
Motor vehicle crash	39	46
Pedestrian	18	21
Fall	9	11
Assault	8	10
Gunshot	4	5
Miscellaneous	6	7
Pre-hospital delays (h)		
≤ 6	25	39
> 6	39	61
GCS		
≤ 8	40	65
> 8	22	35
Location of death		
Dead on arrival	20	24
Intensive care unit	54	64
Casualty	9	11
Operating theatre	1	1
Time of death		
Dead on arrival	20	24
≤ 24 h	28	33
24–72 h	13	16
3–7 days	15	18
> 7 days	8	10
Cause of death		
Airway	6	7
CNS	52	62
Hemorrhage	18	21
Sepsis	4	5
Indeterminate	4	5

CNS central nervous system, GCS Glasgow Coma Scale

^a Percentages may total more than 100 % due to rounding. Percentages calculated for individuals with known values. Data are missing for the following numbers of people: 11 for age; 20 for pre-hospital delay; 22 for GCS

The leading causes of death among all patients with definitely preventable and potentially preventable deaths were CNS injury (50 %) and hemorrhage (28 %) (Table 2).

Table 2 Fifty episodes of deficiencies in care documented in 84 trauma care deaths

	Definitely preventable	Potentially preventable	Total
Type of deficiency			
Pre-hospital delay	7 (37)	15 (48)	22 (44)
Delay in treatment	5 (26)	11 (35)	16 (32)
Inadequate fluid resuscitation	7 (37)	4 (13)	11 (22)
Error in diagnosis	0 (0)	1 (3)	1 (2)
Total	19 (100)	31 (100)	50 (100)
Location of deficiency			
Pre-hospital	9 (47)	18 (58)	27 (54)
Casualty ward	1 (5)	2 (6)	3 (6)
ICU	9 (47)	11 (35)	20 (40)
Total	19 (100)	31 (100)	50 (100)
Cause of death			
Airway	0 (0)	4 (13)	4 (8)
CNS	5 (26)	20 (64)	25 (50)
Hemorrhage	9 (47)	5 (16)	14 (28)
Sepsis	4 (21)	0 (0)	4 (8)
Indeterminate	1 (5)	2 (6)	3 (6)
Total	19 (100)	31 (100)	50 (100)

Percentages may total more than 100 % due to rounding. All data are presented as *N* (%). Association between types and locations of deficiencies of care and preventability of death

CNS central nervous system, *ICU* intensive care unit

Hemorrhage was the leading cause of death among those in the definitely preventable death group (47 % of deaths in that group). Deaths from hemorrhage included patients for whom there was inadequate fluid resuscitation for shock, for whom there were delays in initiating surgical treatment (such as delayed laparotomy for hemoperitoneum), or for whom simple first aid measures such as pressure would have decreased blood loss from external wounds in the pre-hospital setting.

Discussion

This study sought to determine the proportion of preventable trauma deaths at a large hospital in an African city and to identify opportunities for improving trauma care in this setting. The study also sought to evaluate the feasibility of the preventable death panel review process in the study setting. The study found 23 % of trauma deaths to be definitely preventable and 37 % to be potentially preventable, for an overall 60 % preventable. Major types of deficiencies identified were pre-hospital delays, delays in treatment in-hospital (especially in the emergency department), and inadequate fluid resuscitation.

The study findings need to be put into the context of the growing global interest in quality improvement as a way to cost effectively improve medical care overall, including trauma care. WHO has emphasized promotion of simple trauma quality improvement methods globally, in countries at all economic levels. A review conducted by WHO identified 36 articles that reported on the outcome of a trauma quality improvement program. The vast majority (34) found improvements in mortality, other outcome, or process of care, while only two studies detected no difference after a quality improvement program was implemented [7, 13, 14].

In an effort to promote trauma quality improvement programs globally, WHO and the International Society of Surgery developed a set of recommendations [7], which emphasize low-cost, straightforward techniques, applicable to countries at all economic levels. Among the techniques recommended are preventable death panel reviews, including their use within individual institutions, as a means to provide more methodological rigor to morbidity and mortality conferences and their use system-wide [7].

Preventable death panel reviews have been widely used in high-income countries, including Germany, Italy, the Netherlands, the UK, and the USA. Percentages of definitely preventable deaths have ranged from 2 to 11 %. Percentages of potentially preventable deaths have ranged from 10 to 32 %. Percentages of all preventable deaths (including definitely preventable and potentially preventable combined or including the more general term ‘preventable’) have ranged from 7 to 73 %, being higher in older studies [8, 9, 15–24].

Recently, a few reports on use of preventable death panel reviews from LMICs have emerged, including Iran, Nigeria, and Pakistan. Percentages of preventable deaths have tended to be higher than those reported in high-income countries. Definitely preventable deaths have ranged from 22 to 33 %. Potentially preventable deaths have ranged from 3 to 39 %. Percentages of all preventable deaths have ranged from 22 to 72 % [6, 25, 26]. The percentages of preventable deaths reported in the current study are in the ranges reported from other LMICs.

As discussed in subsequent paragraphs, determination of preventability is somewhat subjective [27]. This is especially an issue when trying to compare percentages between different institutions or different countries, in which specific methods for the panel reviews might have differed. Hence, the above comparisons should be regarded as general indications. Nonetheless, all of the authors from LMICs have felt that, regardless of comparisons with high-income countries, the percentages of preventable deaths in their locales are unacceptably high and should be the target for future improvements [6, 25, 26].

Even more important than determination of the preventable death rate is the identification of problems and opportunities for improvements. Preventable death studies from both LMICs and high-income countries have emphasized several common sets of problems. First are delays and inadequate treatment before arrival to the hospital. For LMICs, this includes delays that occur because of overall lack of EMS. For countries at all economic levels, preventable death panels identified delays and inadequate care that arose from lack of organized systems for inter-hospital referral or lack of triage criteria [6, 8, 9, 15–26]. In the current study, the single leading type of deficiency in care identified was pre-hospital delay.

Preventable death studies have also identified several common problems once patients arrive at the hospital. These include inadequate airway management, inadequate fluid resuscitation, and delays in hemorrhage control [6, 8, 9, 11, 15–26]. These problems are reiterated in the current study. For patients with definitely preventable deaths, hemorrhage was the leading cause of death, and inadequate fluid resuscitation was the leading deficiency.

Addressing the above-noted deficiencies for pre-hospital care will not be straightforward. There is a formal EMS in Kumasi, but it is minimally developed and the vast majority of severely ill and injured still arrive to the hospital by private or commercial (taxi or bus) transport. In theory, increasing the capacity of the EMS to cover a greater percent of the need is an option. However, this is likely to be expensive and not the solution for the immediate future. Alternatives such as basic first aid training for commercial drivers have also been tried in some locations. Reports have shown considerable promise, but experience with this method system-wide is limited [28–32]. However, addressing the above-noted deficiencies for hospital-based care is eminently feasible. Most of the deficiencies occurring in the hospital occurred in the emergency department setting (casualty ICU). Improving fluid resuscitation and decreasing delays to emergency surgery for hemorrhage control are not resource intensive.

Preventable death panels have been reported to be especially useful for identifying problems and stimulating corrective action. In a well publicized example in the USA, a high rate of preventable deaths due to disorganized care was identified in Orange County. This finding led to improvements in system-wide care, both in terms of pre-hospital organization, implementation of field triage criteria, and improvements in hospital capabilities. This in turn led to a subsequent decrease in the percentage of all deaths that were preventable from 34 to 15 % [8]. Similar findings were reported from the rural state of Montana in the USA, where iterative improvements in the trauma system gradually decreased deficiencies in care and decreased the overall preventable death rate (definite and

potentially combined) from 13 to 8 % over a 5-year period [9].

The current study has already stimulated improvements at the study site. Given the preponderance of in-hospital preventable deaths in early phases of care, KATH has established a dedicated accident and emergency center (emergency department), increased staffing of both doctors and nurses in that department, and has started the first emergency medicine residency program in West Africa.

In addition to specific problems in trauma care, preventable death studies often have demonstrated the need for better documentation and better ongoing monitoring and evaluation of care, as is provided by quality improvement programs. The current study has shown the feasibility and utility of the preventable death panel review method as a means to implement improved trauma quality improvement in the setting of LMICs.

Before drawing conclusions from the data, the limitations of the study methods must be addressed. First, as with all preventable death panels, determination of preventability is somewhat subjective [27]. In order to minimize the subjectivity, the current study employed standard, rigorous, preventable death panel review methodology, as described by the WHO, including use of a multidisciplinary panel who were very familiar with local realities [7].

Second, of the 231 trauma deaths in the study period, most (147) had insufficient documentation to allow review. All of these deaths were pre-hospital. Many were likely deaths in the field soon after injury and likely not preventable in the study setting. However, the lack of documentation prevents any solid determination of this possibility. This limitation further reinforces one of the findings of the study, which is the importance of the pre-hospital setting for future efforts to improve trauma care.

Third, the cases evaluated are already fairly old, having occurred in 2007. Convening the multidisciplinary panels took a longer period of time to accomplish than initially planned, and the panels met periodically over the subsequent 3–4 years. As noted above, there have been changes in the nature of trauma care in the study site, especially improvements in the emergency department. However, waiting for the multidisciplinary input was felt to be an important step in assuring that this was more than just a one-time study, but rather a step towards institutionalizing quality improvement at KATH.

Conclusions

Despite these limitations, the study results allow us to make reasonable conclusions about trauma care in the study setting. The overall percent of preventable deaths was found to be unacceptably high, at 60 %. This was due to several types

of deficiencies. The most common was pre-hospital delays, which will not be easy to improve upon. The most common types of in-hospital deficiencies were inadequate resuscitation and delays in treatment, with hemorrhage control being especially problematic. Improvements in these deficiencies should not be resource-intensive and are eminently achievable. This study has also shown that preventable death panel reviews are a feasible and useful quality improvement method in the study setting.

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