Hospital stay, morbidity, and mortality in polytrauma patients at Trauma Unit, Assiut University Hospital during 2017

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Aim
The aim of this work is to evaluate the management strategy of polytrauma patients at Assiut University Hospital, it will evaluate the hospital stay and its effect on patients' outcome, main causes of patient morbidity, and mortality in terms of short outcomes.

Patients and methods
All polytrauma patients attending Assiut University Trauma Unit from January 1 to December 31, 2017 were included in the study. Demographic characteristics of patients, injury characteristics, morbidity, and mortality were reviewed.

Results
Total coverage of all trauma patients attending Assiut University Trauma Unit from January 1 to December 31, 2017 were 292 trauma patients. Male sex was predominant demonstrating the majority of patients (68%), and around 70% of the patients were younger than 40. The current study revealed that motor car accident is the main cause of trauma (34%) followed by fall from height (19%) and then motorbike accident (17.5%) followed by train/bus (15.4%). Damage-control surgery was offered to about one-quarter of patients, while early total care is the standard of care for other patients. The trauma-related mortality was around 20%, half of them encountered early, and Central nervous system (CNS) is the leading cause for death.

Conclusion
Trauma is still a leading cause of death in Upper Egypt, trauma-related mortality is still high, despite of our standards of care, and an intensive National Preventive Program is essential to minimize that great trauma burden.

Keywords:
damage-control surgery, early total care, mortality, polytrauma

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Introduction

Severe trauma is still the most frequent cause of death in people below the age of 40. The term 'polytrauma' originates in the Greek words poly (multiple) and trauma (wounds), indicating a complex injury pattern of different anatomical regions [1,2].

The modern definition of polytrauma as a syndrome of multiple injuries of defined severity [injury-severity score (ISS) ≥17] with consecutive systemic reactions, which may lead to dysfunction of remote organs, also comprising the complex host response to the injury [3].

The most accurate definition to the polytrauma patient is the new 'Berlin definition' of the polytrauma patient: significant injuries of three or more points (AIS ≥3) in two or more different anatomic Abbreviated Injury Scale (AIS) regions in conjunction with one or more additional variables from the five physiologic parameters that are hypotension (systolic blood pressure <90 mmHg), level of consciousness (Glasgow Coma Scale score <8), acidosis (base excess <6.0), coagulopathy (international normalized ratio >1.4/partial thromboplastin time >40 s), and age (>70 years) [4].

The complex pathophysiology of the polytraumatized patient requires an effective management in order to protect the victim from the deathly spiral of severe systemic complications such as prolonged hemorrhagic shock, systemic inflammatory response syndrome, and multiple organ-dysfunction syndrome. Therefore, comprehensive knowledge of the underlying pathophysiology and the ideal principles of surgical management are indispensable for successful treatment of multiple injured patients [5].

Treatment of polytrauma requires qualified trauma management that may involve several care professionals. Over the last decade, polytrauma care has developed

into an established trauma center specialty with its own identity and characteristics [6].

The causes of mortality after trauma differentiate between immediate deaths (on scene/within 60 min), early deaths (emergency department or operating room/within 1–4 h), and late deaths that occur more than 1 day after trauma [7].

Aim

The aim of this work was to evaluate the management strategy of polytrauma patients at Assiut University Hospital, the study will evaluate the hospital stay and its effect on patients' outcome, the main causes of patient morbidity and mortality in terms of short outcomes.

Patients and methods

This was a prospective cross-sectional study. All polytrauma patients attending Assiut University Trauma Unit from January 1 to December 31, 2017 were included. Demographic characteristics of patients, injury characteristics, morbidity, and mortality were reviewed.

Total coverage results in 292 trauma patients. Male sex was demonstrating the majority of patients (68%), and around 70% of them were younger than 65.

Medical comorbidities were found in 25% of the patients (hypertension, diabetes mellitus, hepatic, cardiac, or renal disorders). While 75% of them were not known to have previous medical comorbidities.

Our current study revealed that motor car accident is the main cause of trauma (34%) followed by fall from height (19%) and then motorbike accident (17.5%) followed by train/bus (15.4%). Around 6% were assault from others and 8% were unclassified mechanisms of injury.

Patient assessment in the emergency room

Our patients were treated by the ATLS protocol starting by primary survey. The primary survey commences with the cessation of life-threatening condition. This is referred as the ABCDE approach for assessment. There were adjuncts to primary survey like ECG, urinary catheter, monitoring blood pressure, pulse oximeter and arterial blood gases, radiograph for anteroposterior chest, anteroposterior pelvis, and abdominal sonography (focused assessment sonography in trauma [FAST]).

At this stage, of the primary survey, cessation of life-threatening condition was applied like airway obstruction, tension pneumothorax, open pneumothorax, massive hemothorax, mobile chest flap, hemorrhagic shock, or cardiac tamponade. This was by emergency procedures like endotracheal intubation that was done to 81 (27.73%) cases, chest tube insertion to 62 (20.94%) cases, cardiopulmonary resuscitation to 11 (3.76%) cases, and blood transfusion to 189 (64.72%) cases. Once the primary survey was completed, the secondary survey was continued. This consists of a top-to-toe, front to-back full examination.

Ethical consideration

The study was approved by the Ethical Committee of Faculty of Medicine at Assiut University. Informed consent was obtained from each patient.

Statistical analysis

Categorical variables were described by number and percent, where continuous variables were described by mean and SD. *P* value of less than 0.05 was considered statistically significant. All analyses were performed with the IBM SPSS 20.0 Software.

Results

At the end of the secondary survey after evaluation and classification of our patients, they were discharged from the emergency room to the next step; some cases (69 cases, 23.63%) were discharged to the operating room for urgent life-threatening surgery (neurosurgery, cardiovascular surgery, abdominal exploration, vascular surgery, and damage-control orthopedic surgery 'which were done with other life-threatening surgery or alone'), while 101 cases, 34.24%, were transferred to the ICU and 93 patients, 31.84%, were discharged to the inpatient word sector for reassessment and definitive care (Fig. 1).

As regarding the orthopedic management, among 69 cases, 23.63% patients underwent damage control orthopedic (DCOs) (external fixator, traction, and splinting), while 186 (63.698%) cases underwent early total care (ETC). This ETC was done either by internal fixation using plates and screws to 141 cases, or by using intra-medullary nail (IMN) to 91 cases or by casting in children like hip Spica to nine patients, while soft-tissue management was done to 41 cases and we reported in our study that 37 (12.671%) cases died before surgical interference, 29 of them were early deaths at the emergency room, while eight cases were late deaths in ICU.

Complications and hospital stay

In our study, hospital stay ranged from less than 1 day to 72 days and the mean ± SD was 21 ± 16.6, the mean ± SD of ICU stay was 14 ± 11.3.

As regarding complications during the whole hospital stay, it was recorded as respiratory complications, cardiovascular complications, renal, gastrointestinal, metabolic and electrolytes, and orthopedic and miscellaneous.

Total hospital deaths in this study were 56 (19.17%) cases classified as early deaths (first hour) that were 29 (9.93%) and late deaths were 27 (9.24%).

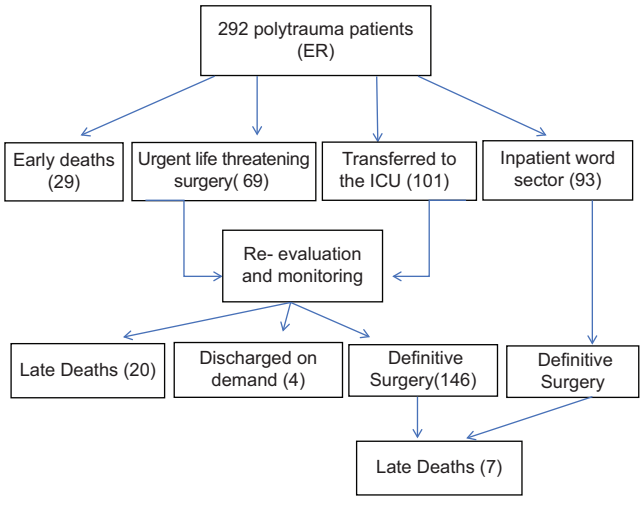
The trauma-related mortality was around 20%, half of them encountered early, and CNS is the leading cause for death. Other causes were exsanguination, multiple-organ failure (MOF), respiratory failure, sepsis, and infrequently unknown.

The study of the predictors of mortality showed that the most significant predictors of mortality are high cranial AIS more than or equal to 4 ($P < 0.001$), high amount of blood transfusion in the first 24 h more than or equal to 5 U ($P < 0.001$), and prehospital intubation ($P < 0.001$) followed by old age ($P < 0.005$), long transportation time ($P = 0.029$), acidosis pH less than 7.35 ($P = 0.031$), and high abdominal and pulmonary AIS more than or equal to 3 ($P = 0.039$, 0.041, respectively). While in previous comorbidity, long ICU and hospital stay were insignificant predictors of hospital mortality (Figs. 2).

Medical expenses for management

In our study, total medical expenses, which included the cost of examination, cost of operation, cost of pharmaceuticals, and other costs (fees for administrative tasks, registration, wards, nursing, blood/plasma tests, anesthesia, hemodialysis, special material costs, and personal expenses, were expressed as cost per victim in Egyptian pounds and also US dollars (Tables 1–8).

Figure 1



Algorithm of polytrauma patients discharge

Discussion

Trauma is among the most serious health problems and it is estimated to be preventable in 90% of cases [8].

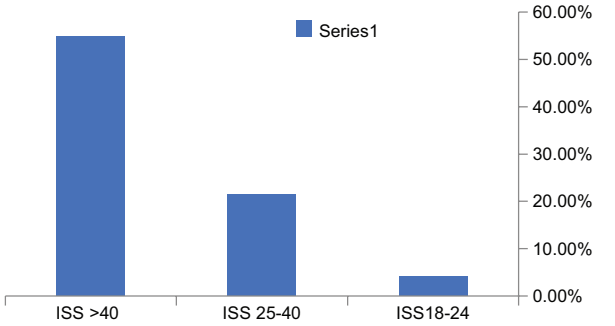
Our study points at injury as a major health problem in Upper Egypt with a special concern to polytrauma patients as these are considered higher in severity and have a worse outcome.

In our study, most cases were among males with a male:female ratio of 2:1. This is due to the fact that males are more likely to be involved in violent activities and road traffic accidents in addition to exposure to work-related stress.

This is in agreement with the Egyptian injury surveillance 2009 report [9] and with other studies performed in Pakistan, Iran, and Uganda [10–12].

This study revealed that the number of injuries were the highest among the young-age group less than or equal to 65 years (76%) than the older-age group (24%). This provides the evidence that the young-age group less than or equal to 65 years is the main group at risk for trauma because they possess unlimited freedom and outdoor activities. This is consistent with that reported by Egyptian injury surveillance 2009, which revealed that the highest distribution occurred in ages

Figure 2



Analysis of this data showed that there was significant correlation between the mortality rate and the high ISS >40 this may be explained due to severe (Cranial, Pulmonary, Abdominal and extremity). Injuries which are very serious causes of rapid deterioration of the general condition and those patients need massive amount of blood transfusion which indicate severe blood loss (internal or external) and had a lot of complications like hypothermia, coagulopathy and acidosis which are the lethal triad of death

20–30 and there is a decline with increase of age [9]. Other studies in India, Tanzania, and Iran [13–16] are consistent with this finding. These studies revealed that injury is most common in the age group of 15–44 years.

Table 1: Associated injuries in polytrauma patients

Body region AIS≥3	No.	%
Head Injury	121	41.43%
GCS		
≤8	71	24.31%
9-12	43	14.72%
≥13	178	60.97%
Neck Injury	31	10.61%
Facial Injury	59	20.21%
Spine Injury	29	9.93%
Chest Injury	78	26.71%
Abdominal Injury	39	13.35%
Upper Extremity Injury	149	51.02%
Lower Extremity Injury	164	56.16%
External & Others	4	1.36%
ISS mean±SD	34±8.1	
17-24	97	33.21%
25-40	164	56.16%
>40	31	10.63%

Table 2: Associated extremity injuries in polytrauma patients

Extremity	No. (%)	
Clavicle, scapula fracture	51 (17.46%)	
Humeral fracture	39 (13.35%)	
Radius/ulna or both	43 (14.72%)	
Wrist/hand fracture	29 (9.93%)	
Pelvic fracture	44 (15.06%)	
femoral fracture	83 (28.42%)	
Tibia/fibula or both	61 (20.89%)	
Foot and ankle	21 (7.19%)	
Amputation	17 (5.82%)	
Open vs closed fractures	Open fractures: 63	21.57%
	Closed fractures: 229	78.43%

In this study, road traffic accident (RTA) was the first cause of polytrauma (34%), followed by fall from height (19%). This agrees with the Egyptian injury surveillance report 2009, in which RTA is one of the leading causes of trauma [9]. The coverage of this injury surveillance was for one-third of the institutions (mainly government institutions), so the comparison would be of value. Findings from studies in Tanzania, Manipal, and Syria agreed with this finding as RTA is one of the leading causes of injury in rural and urban population [17–19].

Ranking of RTAs as the first cause of polytrauma could be because higher morbidity and mortality rates in Assiut governorate are an average of 6.5 people injured or passed away per road traffic accident [9].

In a similar study about admitted cases in our trauma unit in a different study period, transport accidents were the first cause of admission and comprised 31.1% of all hospitalized cases and the first cause of mortality (56.4%) [20]. These findings raise priority of attention in prevention to decrease the burden of injury morbidity and mortality. Transport accidents ranked the first leading cause of deaths from 2002 to 2009 according to a study performed in the same trauma unit among hospitalized cases [20].

In the current study, damage-control surgery was offered to about one-quarter of patients, most of them were unstable patients, that is consistent with the higher ISS encountered in the polytrauma patients, while ETC was the line of care for most of our patients. These results are comparable to other retrospective comparative studies on patients with multiple trauma admitted to

Table 3: Assessment of the four clinical grades (triage).

Parameter	Stable (grade I)	Borderline (grade II)	Unstable (grade III)	In extremis (grade IV)
Shock				
BP (mmHg)	>100	80-100	60-80	<60
Blood units (2 h)	0-2	2-5	5-15	>15
Class of He	I	II-III	III-IV	IV
UO (mL/h)	>150	50-150	<100	<50
Coagulation				
Platelet count mg/mL)	>110000	90000-110000	70000-90000	<70000
Factor II and V (%)	90-100	70-80	50-70	<50
Temperature				
>35	>35	33-35	30-32	< 30
Soft tissue Injuries				
Lung function, PaO_2/FiO_2	>350	300	200-300	<200
Chest trauma scores, AIS	AIS I-II	>II	>II	>III
TSS	0	I-II	II-III	IV
Abdominal trauma (moore)	<II	<III	III	>III
Pelvic trauma	A	B or C	C	C (crushed)
Extremities	AIS I or II	II-III	III- IV	crushed

This table shows that the patients were classified to four classes based on the general status: stable patients (green cards):103 cases (35.27%) , borderlinepatients (yellow cards): 143 cases (48.97%) , unstable patients (red cards) :37 cases (12.67%) and in extremis (red to black cards): 9 cases (3.09%) this was based on clinical and laboratory evaluation as on the following table

Table 4: Complications during hospital stay

	Complications	No. (292)	%
Respiratory (53)	Chest Infection	31	10.616%
	Bronchospasm	9	3.08%
	Lung collapse	2	0.684%
	Pulmonary edema	3	1.027%
	Tracheal stenosis	1	0.342%
	pulmonary embolism	3	1.027%
	ARDS	4	1.369%
Cardiovascular (72)	Anemia	34	11.64%
	Persistent hypotension	26	8.90%
	Arrhythmias	2	0.684%
	Cardiac arrest	5	1.712%
	Hypertension	2	0.684%
	thromboembolic disease	3	1.027%
Renal (9)	Renal Failure	1	0.342%
	UTI	8	2.73%
Gastrointestinal (3)	Diarrhea	3	1.027%
Metabolic and electrolytes (7)	Electrolyte imbalance	6	2.054%
	Hyperglycemia	1	0.342%
Orthopedic (55)	Vascular injuries	4	1.369%
	Infection after IF	19	6.506%
	Pin track infection	17	5.821%
	Amputation	6	2.054%
	Failed surgery (revision)	9	3.082%
Miscellaneous (40)	Bed sores	9	3.082%
	Local wound Infection	17	5.821%
	Convulsions	1	0.342%
	Jaundice	3	1.027%
	Septicemia	5	1.712%
	Depression	1	0.342%
	SIRS	4	1.369%

Analysis of this data showed that there was no significant difference in the incidence of cardiovascular, renal, gastrointestinal, metabolic and Orthopedic complications between the three groups (A-B-C). While there was significant increase of the incidence of respiratory and miscellaneous complications between group A <one week (3.84%) and group C >2 weeks (26.79% respiratory and 28.75% miscellaneous) with *P*<0.05

Table 5: Percentage of complications according to duration of stay

Hospital stay	Respiratory	Cardio vascular	Renal	Gastrointestinal	Metabolic and electrolyte	Miscellaneous	Orthopedic
<one-week (52) A	2 (3.84%)	15 (28.84%)	1 (1.92%)	--------	1 (1.92%)	2 (3.84%)	6 (11.53%)
1-2 weeks (87) B	10 (11.49%)	20 (22.98%)	2 (2.29%)	--------	2 (2.29%)	9 (10.34%)	9 (10.34%)
>2 weeks (153) C	41 (26.79%)	37 (24.18%)	6 (3.92%)	3 (1.96%)	4 (2.61%)	44 (28.75%)	25 (16.33%)

Hospital stay of our patients ranged from less than one day to 72 days and the mean±SD was 21±16.6, our patients were divided to three groups: <1 week 52 cases (17.8%) , 1-2 weeks 87 cases (29.8%) and More than 2 weekswere 153 cases (52.4%), the mean±SD of ICU stay was 14±11.3

Table 6: Correlation of ISS and duration of stay

ISS/LOS	<1 week (no. 52)	1-2 weeks (no. 87)	>2 weeks (no. 153)
A-ISS 18-24 (no 97)	17	42	38
B-ISS 25-40 (no. 164)	16	41	107
C-ISS >40 (no. 31)	19	4	8

Analysis of this data showed that there is no significant correlation between hospital stay and ISS ingroup A (ISS 18-24) *P*=0.21, while group B (ISS 25-40) had long duration of hospital stay >2 weeks 107 patients (65.24% of group B), and group C (ISS >40) had short duration of hospital stay <1 week 19 cases (61.29% of group C) *P*=0.096 , this short hospital stay may indicate the severity of the trauma and early deaths

two level-I trauma centers in Germany and Australia to show the difference in attitude between surgeons. The patients had similar ISS, they mentioned that ETC versus DCO was 70 versus 30% in Australia and 30 versus 70% in Germany, respectively. Interestingly, surgeons in the German hospital had a lower threshold for indicating DCO for patients with traumatic brain injury compared with Australians [21].

In our study, hospital stay ranged from less than 1 day to 72 days and the mean ± SD was 21 ± 16.6, the mean ± SD of ICU stay was 14 ± 11.3, and it was noticed in our study that there is no significant correlation between hospital stay and ISS in group A (ISS 18–24), *P* value of 0.21, while group B (ISS 25–40) had a long duration of hospital stay more than 2 weeks (65.24% of group B), and group C (ISS >40) had a short duration of hospital stay less than 1 week (61.29% of group C), *P* value of 0.096, this short hospital stay may indicate the severity of the trauma and early deaths. These

Table 7: Predictors of Mortality in polytrauma patients, AUH.

	ß	SE	*P*
Age ≥ 65ys	1.76	0.281	<0.005
Long Transportation Time	1.12	0.327	0.029
Previous Co-morbidity	0.252	0.340	0.459
Pre-hospital intubation	1.84	0.312	<0.001
AIS:			
Cranial ≥4	1.91	0.311	<0.001
Abdominal ≥3	0.91	0.521	0.039
Pulmonary ≥3	0.821	0.337	0.041
Extremities ≥3	0.456	0.417	0.231
Number of packed RBCs units used within 24 h ≥5 units	1.88	0.421	<0.001
pH <7.35	0.894	0.412	0.031
ICU stay	0.292	0.319	0.18
LOS	0.311	0.305	0.16

*P<0.05. Table (10): showing that the most significant predictor of mortality is high Cranial AIS, High amount of blood transfusion and pre hospital intubation with P<0.001. followed by old age, long transportation time, acidosis and high abdominal and pulmonary AIS with P=0.005, 0.029, 0.031, 0.039 and 0.041 respectively). While Previous Co-morbidity, long ICU and hospital stay are insignificant predictors of hospital mortality.

results are comparable to another study in Netherlands 2017, they mentioned that hospital stay in the majority of cases was more than 2 weeks [22], another study in New Delhi 2004 noticed that there was no significant correlation between the ISS and duration of ICU stay in the two peaks of ISS less than 20 and more than 40, and they noticed that longer ICU stay in patients had ISS between (20 and 40) [23].

In the current study, complications during hospital stay were recorded as respiratory, cardiovascular, renal, gastrointestinal, metabolic and electrolytes, and orthopedic and miscellaneous; analysis of these complications showed that the most frequent complications were chest infection (10.616%), anemia (11.64%), hypotension (8.90%) and other infection urinary tract infection (2.73%), local wound infection (5.821%), pin-track infection (5.821%), infection after internal fixation of fractures (6.506%), or septicemia. While the least common complications were convulsions, depression, jaundice, renal failure, and tracheal stenosis (0.342%), these results are comparable to another study in New Delhi 2004 [23] that noticed that the predominant complications seen in trauma admissions to the ICU were chest infection (36%), anemia (33%), hypotension (28%), and bedsores (11%). The main factors influencing morbidity were duration of stay and age of the patients. Anemia and hypotension were the predominant complications seen in patients who stayed for less than 3 days in the ICU. The incidence of chest infections, gastrointestinal complications, and bedsores increased as the duration of stay of the patients increased [23].

Table 8: Medical expenses/costs for management of polytrauma patients AUH 2017

Service	Egyptian pounds	US dollars
Cost of examination	11376±9918	632±551
Cost of operations	19080±18018	1060±1001
Cost of pharmaceuticals	13392±12654	744±703
Cost of ICU and hospital stay	15876±13824	882±768
Others	20016±17964	1112±998
Total Medical expenses per victim (mean±SD)	79740±74250	4430±4125

Evaluation of this data indicate the very high cost of management of polytrauma patients in hospital with out adding the cost of lost vehicles or road problems plus the cost of patients rehabilitation and absence of work and it's effect on the community

A major finding in this study was that the majority of the mortality (87.5%) was because of the consequences of primary trauma and not because of complications during hospitalization. The mortality rate because of complications was low (12.5%). This can be a result of many improvements in trauma and intensive care during the past decades, these results are comparable to a study in Netherlands 2017 [22], they noticed that the mortality rate because of consequences of primary trauma was 91.7% and due to complications was 8.3%.

The predominant cause of death in a study in Netherlands was CNS injury (40%), followed by exsanguination (23%). They attributed the predominant cause of death to the respiratory failure (16%), followed by MOF (9%), which were the complications [22].

When comparing this with our study, a similar pattern can be observed, with CNS injury (43%), worldwide ranging from 21.6 to 71.5%, exsanguination (20%), and MOF (9%).

Our study reported that the mortality rate among the polytrauma patients was 19.1%, which is comparable to other studies [12,20].

In the present study, the mortality cases had a higher ISS, lower Glasgow Coma Scale, and shorter hospital stay in comparison with the survivors' group indicating a higher degree of trauma and early death.

The study of the predictors of mortality showed that the most significant predictors of mortality are high cranial AIS more than or equal to 4, high amount of blood transfusion in the first 24 h more than or equal to 5 U, and prehospital intubation followed by old age, long transportation time, acidosis pH less than 7.35, and high abdominal and pulmonary AIS more than or equal to 3. While previous comorbidity, long ICU, and hospital stay were insignificant predictors.

These findings are expected as predictors of mortality due to the fact that severe (cranial, pulmonary, and

abdominal) injuries are very serious causes of rapid deterioration of the general condition; also, elderly patients cannot tolerate severe trauma or blood loss. Massive blood transfusion indicates severe blood loss (internal or external) and has a lot of complications like hypothermia, coagulopathy, and acidosis that are the lethal triads of death.

Comparing our results as the predictors of mortality [22], noticed that old age more than 60, intubation in the ED, acidosis pH less than 7.35, massive blood transfusion, high cranial AIS more than or equal to 4, and high pulmonary AIS more than or equal to 3 were the most significant predictors of mortality.

Conclusion

Trauma is still a leading cause of death in Upper Egypt, trauma-related mortality is still high, despite of our standards of care, and it is comparable to other countries, and an intensive national preventive program is essential to minimize that great trauma burden.

Limitations

This study has several limitations, such as unknown deaths at the scene of accident, which could yield a different mortality rate. Also, some missing data from the prehospital condition of patients.

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Conflicts of interest

There are no conflicts of interest.

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