Mortality of hospitalized trauma patients in Abu Dhabi Emirate: Data from a National Trauma Registry

David O. Alao (davidalao@uaeu.ac.ae)
United Arab Emirates University
Arif Alper Cevik
United Arab Emirates University
Fikri M. Abu-Zidan
United Arab Emirates University, Tawam Hospital

Research Article

Keywords: Major trauma, deaths, location of death, mode of death

Posted Date: February 22nd, 2023

DOI: https://doi.org/10.21203/rs.3.rs-2601108/v1

Abstract

Aim

To study the epidemiology and pattern of trauma-related deaths of hospitalised patients in Abu Dhabi, the United Arab Emirates, using the DOH trauma registry of Abu Dhabi in order to improve trauma management and injury prevention.

Methods

Data were retrieved from The Abu Dhabi Trauma Registry which prospectively collects trauma data of all hospitalized patients from 7 major trauma centres in the Abu Dhabi Emirate. We have studied all trauma patients who died on arrival or after admission to these hospitals from January 2014 to December 2019.

Results

There were 453 deaths constituting 13.5% of all trauma deaths in the Abu Dhabi Emirate. 82% of the deaths were young males with a median (IQR) age of 33 (25–45) years. 85% of the deaths occurred in the emergency department (ED) and the intensive care unit (ICU). Motor vehicle collisions (63.8%) and falls (19%), causing mainly head injuries (45.5%) or injuries to two body regions (24.7%), were the two predominant mechanisms. Two out of the seven hospitals admitted close to 50% of all the trauma cases but accounted for only 25.8% of the total deaths, while 75% occurred in the remaining five hospitals ($p < 0.001$). Those who died in the ward (7%) were significantly older, with a median (IQR) age of 65.5 (31.75–82.25) years ($p < 0.001$) and 34.4% of them were females ($p = 0.09$). The median (IQR) GCS of those who died in the ward was 15 (5.75-15) compared with 3 (3–3) for those who died in the ED and ICU ($P < 0.001$).

Conclusions

Death from trauma predominantly affects young males in our setting. Motor traffic collisions and falls are the two leading causes. Over 85% of hospital deaths occurred in the ICU and ED from head injuries and injuries affecting two body regions. Primary prevention of traffic accidents through legislation and enforcement can mitigate prehospital death, while secondary prevention targeting improved care in the ED and ICU will improve in-hospital mortality.

Introduction

Major trauma is the leading cause of death among persons below the age of 44 years. Worldwide, 4.4 million people die, and tens of millions more are left with disabilities from major trauma annually. Evidence shows that the health burden is far higher in low and middle-income economies [1]. The United Arab Emirates (UAE) is a high-income developing country with one of the highest GDPs per capita in the world [2]. The country has experienced rapid infrastructural development in the last three decades, with a significant increase in civil construction work and transportation [3]. These developments have come with a significantly increased incidence of injuries from falls and motor vehicle collisions. Injury, including road traffic collisions, self-harm, and falls, is now the second leading cause of death in the UAE [4]. Previously published studies on trauma-related deaths in the UAE have focused mainly on specific patient groups such as intensive care unit (ICU) deaths [5] and isolated mechanisms such as road traffic collisions (RTC) [6], making generalisations of the results difficult. We reported in a previous study how multiple interventions, such as introducing speed cameras, banning child camel racing and increasing educational awareness on speeding, had reduced in-hospital trauma mortality from 2.3% in 2003 to 1.0% in 2014 in Al Ain City, Abu Dhabi Emirates [7].

In 2014, a trauma database was established by the Department of Health (DOH) of Abu Dhabi to assess the magnitude and trend of major trauma in the Emirates. Five trauma-receiving hospitals contributed data to the registry at its inception. Two additional hospitals in the region contributed patients to the registry during the study period. We think that it is now time to analyse important data from this national trauma registry from the UAE. Studying the epidemiology and pattern of trauma deaths will provide information that can be used for health policy planning and interventions, which may further reduce trauma deaths in our setting.

We aimed to study the epidemiology and pattern of trauma-related deaths of hospitalised patients in Abu Dhabi, the United Arab Emirates, using the DOH trauma registry of Abu Dhabi in order to improve trauma management and injury prevention.

Patients And Methods

Ethical Considerations: The study was approved by the Department of Health (DOH) of the Abu Dhabi Emirate. (Ref: DOH/CVDC/2021/932). The patients or their caregivers gave their written informed consent to use their data for research.

Study design

Retrospective analysis of the prospectively collected data of the Abu Dhabi Trauma Registry, Abu Dhabi, UAE.

Setting

Abu Dhabi Emirate, which has three regions, had a population of 2.91 million during 2016. Out of which, 1,807,000 were in the Abu Dhabi region, 766,900 were in the Al-Ain region, and 334,000 were in the western region of Abu Dhabi [8].

The Abu Dhabi Trauma Registry

This registry was started in 2014 by a legislative order of the Department of Health. The registry was based on the American College of Surgeons' National Trauma Data Bank dataset. It prospectively collects data on all trauma patients who die in the hospital or are admitted for more than 24 hours. There are seven contributing hospitals – three from the Abu Dhabi City region (Mafraq, Khalifa Medical Centre and Al Rahba Hospitals), two hospitals from the Al Ain City region (Tawam and Al Ain Hospitals) and two hospitals from the Western Region (Al Gharbia and Al Ruwais) (Fig. 1). Trained registry nurses enter the data. The two community-based teaching hospitals in Al Ain city serve a population of 750,000 inhabitants in the Al Ain region of Abu Dhabi Emirates, the United Arab Emirates [9]. Each hospital has 450 in-patient beds with a full tertiary service of neurosurgery, orthopaedic, general surgery and critical care. In the Abu Dhabi region, the two hospitals, Sheikh Khalifa Medical City (SKMC) hospital and Mafraq hospital, have a bed base of 450 each and complete tertiary services, including critical care, neurosurgery, orthopaedic and general surgery. The latter hospital was closed in January 2020 and was replaced by an ultra-modern 741-bed hospital – the Sheikh Shakhbout Medical City (SSMC) Abu Dhabi – in the same location. The third hospital in Abu Dhabi region, Al Rahba, has 166 beds and provides secondary-level care. The two hospitals in the Al Dhafrah region namely, Al Gharbia (150 beds) and Al Ruwais (132 beds), also provide secondary-level care.

Study population

We included in the study all trauma patients who died on arrival or after admission to the hospital during the period of January 2014 to December 2019.

Studied variables

Studied variables included patients' demographics, initial emergency department (ED) physiological parameters, Glasgow Coma Scale (GCS), Injury Severity Score (ISS), location of death, time of death, mechanism of injury, location of injury, ICU and hospital length of stay, ED discharge destination, and total length of stay in the ED.

Statistical Analysis: Data were presented as median (IQR) or number (%) as appropriate. Patients were divided into four groups depending on the hospital location where they died: the Emergency Department (ED), the operating theatre, the ICU, and the ward. The groups were compared using the Kruskal-Wallis's test for continuous or ordinal data for more than two groups and Fisher's Exact test or Pearson's Chi-Square for categorical data as appropriate. The IBM SPSS Statistics Program version 28 (SPSS Inc, Chicago, IL, USA) was used to analyse the data with a *p*-value of less than 0.05 to be statistically significant.

Results

Over the study period, data from 30,239 hospitalized trauma patients were entered into the registry. Twenty-nine thousand seven hundred nine patients (98.2%) survived; 453 died (1,5%), while the outcome was unknown in 77 (0.25%) patients. Over the six-year study period, an average of 76 *patients died per year, with an incidence of 2.6 per 100 000 population* [8]. There were 562 injury deaths in the Abu Dhabi Emirate in 2017 [9] indicating that deaths of hospitalized trauma patients constituted only 13.5% of all deaths, with most deaths occurring in the prehospital setting. Figure 2 shows the distribution of the location where the death occurred. The majority (85%) occurred in the ICU (51.7%) and the ED (33.3%). Only 15% occurred in the operating theatre and wards, with almost an equal distribution.

Table 1 demonstrates the demography of the trauma deaths. A majority (82%) were males. RTC was the leading cause of death (63.8%), followed by fall from height (11.3%), fall on the same level (7.7%) and assault (7.1%). Those who died in the wards were significantly older ($p < 0.001$) – double the age compared with other locations – tended to be female ($p = 0.09$), a percentage of more than double those in different locations, with a large proportion of UAE nationals (43.8%, $p = 0.046$), and a significantly higher number who died from a fall from the same level (50%, $p < 0.001$). A significant number of those who died in the ward were transported to the hospital using private cars ($p < 0.001$). There was no significant difference in the injury place between the four groups of dead patients. There were significant differences in the location of death between the hospitals where the death occurred ($p < 0.001$). The majority of deaths in the ED occurred in Hospital B (31.8%); the majority of deaths in the operating room occurred in Hospital A (38.9%); the majority of deaths in the ICU (43.2%), and in the wards (43.8%) occurred in Hospital C.

Table 1
Demography of patients by death place

Variable	Overall n = 453	Emergency Room n = 151	Operating room n = 36	ICU n = 234	Ward n = 32	P value
Age	33 (25–45)	32 (23–42)	31 (23–45)	32 (25–43)	65.50 (31.75–82.25)	< 0.001
Gender						0.09
Female	82 (18.1)	22 (14.6)	6 (16.7)	43 (18.4)	11 (34.4)	
Male	371 (81.9)	129 (85.4)	30 (83.3)	191 (81.6)	21 (65.6)	
Nationality						0.046
UAE	123 (27.2)	46 (30.5)	6 (16.7)	57 (24.4)	14 (43.8)	
Non-UAE	330 (72.8)	105 (69.5)	30 (83.3)	177 (75.6)	18 (56.3)	
Hospital						< 0.001
A (n = 7210)	57 (12.6)	16 (10.6)	14 (38.9)	21 (9.0)	6 (18.8)	
B (n = 4136)	98 (21.6)	48 (31.8)	3 (8.3)	39 (16.7)	8 (25.0)	
C (n = 5050)	135 (29.8)	19 (12.6)	1 (2.8)	101 (43.2)	14 (43.8)	
D (n = 3630)	74 (16.3)	23 (15.2)	11 (30.6)	37 (15.8)	3 (9.4)	
E (n = 7015)	60 (13.2)	34 (22.5)	6 (16.7)	20 (8.5)	0 (0.0)	
F (n = 1659)	20 (4.4)	4 (2.6)	1 (2.8)	14 (6.0)	1 (3.1)	
G (n = 319)	9 (2.0)	7 (4.6)	0 (0.0)	2 (0.9)	0 (0.0)	
Transportation						< 0.001
Ambulance	408 (90.1%)	131 (86.8)	33 (91.7)	222 (94.9)	22 (68.8)	
Private car	45 (9.9)	20 (13.2)	3 (8.3)	12 (5.1)	10 (31.3)	
Injury place						0.67
Public roads	131 (39.2)	32 (31.4)	14 (43.8)	78 (44.1)	7 (30.4)	
Home	113 (33.8)	41 (40.2)	10 (31.3)	55 (31.1)	7 (30.4)	
Work	48 (14.4)	12 (11.8)	6 (18.8)	24 (13.6)	6 (26.1)	
Public areas	30 (9.0)	11 (10.8)	2 (6.3)	15 (8.5)	2 (8.7)	
Desert/sea/water	10 (3.0)	5 (4.9)	0 (0.0)	4 (2.3)	1 (4.3)	
Farm	2 (0.6)	1 (1)	0 (0.0)	1 (0.6)	0 (0.0)	
Mechanism of injury						< 0.001
MVC	289 (63.8%)	114 (75.5)	21 (58.3)	150 (64.1)	4 (12.5)	
Fall from height	51 (11.3)	16 (10.6)	9 (25.0)	24 (10.3)	2 (6.3)	
Fall same level	35 (7.7)	3 (2.0)	1 (2.8)	15 (6.4)	16 (50.0)	
Falling object	18 (4.0)	4 (2.6)	1 (2.8)	12 (5.1)	1 (3.1)	

Continuous and ordinal data are presented as median (25–75 IQR) while categorical data are presented as number (%).

P = Krusall-Wallis test, Fisher's Exact test or Pearson Chi Square as appropriate.

Percentages are calculated from valid numbers excluding missing data. Number may not add to 453 because of missing data

Variable	Overall n = 453	Emergency Room n = 151	Operating room n = 36	ICU n = 234	Ward n = 32	P value
Machinery	3 (0.7)	0 (0)	1 (2.8)	2 (0.9)	0 (0.0)	
Assault	32 (7.1)	9 (6.0)	3 (8.3)	19 (8.1)	1 (3.1)	
Burn	25 (5.5)	5 (3.3)	0 (0.0)	12 (5.1)	8 (25)	
Continuous and ordinal data are presented as median (25–75 IQR) while categorical data are presented as number (%).						
P = Krusall-Wallis test, Fisher’s Exact test or Pearson Chi Square as appropriate.						
Percentages are calculated from valid numbers excluding missing data. Number may not add to 453 because of missing data						

Table 2 shows that the maximum injured regions were significantly different between the patients depending on their death place. The head/brain occurred in 45.5% of the patients and was higher in those who died in the ED (50.3%) and the ICU (49.6%). Chest injuries were higher in those who died in the ED (17.2%). Those who had two body regions injured were higher in those who died in the operating room (30.6%) and the ICU (30.8%).

Table 2
Maximum injured region by death place

Region	Overall n = 453	Emergency Room n = 151	Operating room n = 36	ICU n = 234	Ward n = 32	P value
						< 0.001
Head/brain	206 (45.5)	76 (50.3)	11 (30.6)	116 (49.6)	3 (9.4)	
Chest/lungs	35 (7.7)	26 (17.2)	4 (11.1)	5 (2.1)	0 (0.00)	
Abdomen	8 (1.8)	4 (2.6)	1 (2.8)	3 (1.3)	0 (0.00)	
Pelvis	10 (2.2)	4 (2.6)	1 (2.8)	4 (1.7)	1 (3.1)	
Spine	8 (1.8)	3 (2.0)	1 (2.8)	1 (0.4)	3 (9.4)	
Extremities	21 (4.6)	5 (3.3)	2 (5.6)	3 (1.3)	11 (34.4)	
2 body regions	112 (24.7)	23 (15.2)	11 (30.6)	72 (30.8)	6 (18.8)	
3 or more body regions	27 (6.0)	3 (2.0)	5 (13.9)	19 (8.1)	0 (0.00)	
Not specified	26 (5.7)	7 (4.6)	0 (0.00)	11 (4.7)	8 (25.00)	
Total	453 (100)	151 (100)	36 (100)	234 (100)	32 (100)	
Data are presented as number (%).						
P = Fisher’s Exact test or Pearson Chi Square as appropriate.						
Percentages are calculated from valid numbers excluding missing data. Number may not add to 453 because of missing data						

Table 3 shows the severity markers by death place, including systolic blood pressure, pulse per minute, respiratory rate, GCS, trauma team response, time in the ED, ventilation time, ISS, ICU stay, and hospital stay. All these markers were significantly different between the four groups of patients ($P < 0.001$ in each). Those who were declared dead in the ED were mainly without systolic blood pressure and pulse. Those who died in the ward had a median SBP of 130 mmHg. Those who died in the ED and ICU had a median GCS of 3, while those who died in the ward had a median GCS of 15 (Fig. 3). Those who died in the operating room and ICU had significantly higher ISS (almost double) compared with those who died in the ED and ward (Table 3, Fig. 4).

Table 3
Severity markers by death place

Variable	Overall n = 453	Emergency Room n = 151	Operating room n = 36	ICU n = 234	Ward n = 32	P value
SBP	108 (0-140)	00 (00–00)	104.50 (78.25–135.00)	121.00 (98–148)	130 (102.25–146)	< 0.001
Pulse	88 (35–118)	00 (00–15)	104.50 (77.25-123.75)	102 (78-124.50)	91.50 (80.50-116.75)	< 0.001
RR	18 (00-22.25)	00 (00–00)	20 (15.50–25.50)	20 16–24)	18 (18–22)	< 0.001
GCS	3 (3–7)	3 (3–3)	5 (3–13)	3 (3–8)	15 (5.75-15)	< 0.001
Response level						< 0.001
No activation	16 (3.5)	7 (4.6)	0 (0.00)	8 (3.4)	1 (3.1)	
Only consultation	119 (26.3)	40 (26.5)	4 (11.1)	53 (22.6)	22 (68.8)	
Full code	312 (68.9)	102 (67.5)	32 (88.9)	170 (72.6)	8 (25.0)	
Time in ER	138 (70–222)	97 (21-195.5)	118.50 (69.5-171.50)	156 (100–231)	223.50 (00-344.25)	< 0.001
Ventilation time	2 (0–11)	0 (0–1)	2.5 (1.00-8.75)	9 (3–17)	2.50 (00–7.00)	< 0.001
ISS	22 (10–33)	10 (4–25)	22 (16–34)	25 (17–34)	13.00 (9.00–25.00	< 0.001
ICU stay	3 (0–11)	0 (00–00)	3 (00-10.50)	9.00 (3.75-17.00)	6.00 (1.25–18.50)	< 0.001
Hospital stay	2 (1–11)	1.00 (1.00–1.00)	2 (1.00-9.50)	8.50 (3.00–16.00)	6.00 (3.25–23.25)	< 0.001

Continuous and ordinal data are presented as median (25–75 IQR) while categorical data are presented as number (%).

P = Krusall-Wallis test, Fisher's Exact test or Pearson Chi Square as appropriate.

Percentages are calculated from valid numbers excluding missing data. Number may not add to 453 because of missing data

Time spent in the ED had a median of 138 minutes. This was significantly different between patients of the four groups (Fig. 5). The time spent in the ED was the longest for those who died in the ward, followed by those who died in the ICU, operating room and finally, the ED. There was a significant difference in the time spent in the ED between the seven hospitals ($p < 0.001$) (Fig. 6).

Table 4 shows the standardized death incidence of hospitalized trauma patients in the three regions of the Abu Dhabi Emirate. The maximum death incidence was in the Al-Ain Region (3.37/100 000 population), followed by the Abu Dhabi City region (2.48/100 000 population) and the Al Dhafra Region (1.45/100 000 population). The median time spent in the ED for those who died in the Al-Ain City Region was 183 minutes compared with 125 in the Abu Dhabi City Region and 73 in the Western Region. However, ISS in the Al-Ain City Region was significantly less (Median (IQR) 17 (9–28) compared with 25 (13–34) and 25 (17–39)) in the other two regions.

Table 4
shows the standardised death incidence of hospitalised trauma patients in the three regions of Abu Dhabi Emirate.

Variable	Abu Dhabi Region	Al Ain Region	Western Region	P value
Trauma Deaths over 6 years	269	155	29	
Annual deaths	44.83	25.83	4.83	
Population	1 807 000	766 900	334 000	
Standardised Deaths/100 000	2.48	3.37	1.45	
SBP	106 (50–140)	111 (0-138)	90 (0-134)	0.53
GCS	3 (3–7)	3 (3–8)	3 (3–8)	0.98
ISS	25 (13–34)	17 (9–29)	25 (17–39)	0.01
Time in ED (min)	125 (66–202)	183 (104–272)	73 (34–124)	< 0.001
Data were standardised using the population in 2016 (Mid period) [Abu Dhabi Health statistics 2017]				

Discussion

This study has shown that hospitalized trauma deaths constitute only 13.5% of all trauma deaths in Abu Dhabi. Eighty-two per cent (82%) of the deaths were in young males, and 85% occurred in either the ED or the ICU. Motor vehicle collisions, causing mainly head injuries or injuries to two body regions, and fall from height were the two predominant mechanisms in the patients who died. The in-hospital mortality rate of 1.5% is less than the 4.7% reported in the United States [10]. The low incidence of death in this study reflects our registry criteria, which allows for the inclusion of trauma patients with low ISS.

In the suggested classical trimodal distribution of trauma deaths in the USA, over 50% of the deaths occur in the first few minutes to hours before the patients reached the hospital [11]. The 86% prehospital death rate in our study is more than the reported range of 30–70% [12]. In the present study, most of the deaths in the ED were in patients with no vital signs on arrival. These patients could arguably be classified as prehospital deaths, thus further increasing the proportion of those who died in a prehospital setting. The high prehospital death rate may reflect the primary injury severity and prolonged transfer time. Increased injury severity rate, defined as the ratio of injury and fatality per 1000 road traffic accidents, has been previously reported in our setting [13]. A prolonged extrication and transfer time of injured patients to the hospital is also a possible reason. The current study did not look at the ambulance on-scene and transfer times. However, the geographical distribution of the trauma centres and the land mass of the Abu Dhabi Emirate, which represents 87% of the UAE land mass, may suggest that delayed transfer time is a contributory factor. This is mitigated by the good road network and the interventions provided by our EMS, which are limited to providing airway support and hemorrhage control, leading to a ‘scoop and run’ approach.

Gunst et al. described a bimodal distribution of deaths, where the first peak occurred in the prehospital phase, followed by a second peak several days later [14]. More recent studies have shown an early peak occurring within minutes and a few hours, followed by a gradual decrease in deaths over time without any peak [15]. The current study showed two definite in-hospital peaks; one in the ED, which was immediate, and a second in the ICU which occurred over several days. Rather than looking at trauma deaths as a function of time, which has been shown to be related to the time model used [16], we chose instead to look at the locations in the hospital where the deaths have occurred. This will help to identify where intervention measures and resource allocation can be most effective when patients arrive to the hospital. Our results show the ED (33.3%) and the ICU (51.7%) as the two areas where most of the deaths have occurred and where intervention measures could be directed.

In this study, head injuries accounted for over 45% of the deaths while hemorrhagic deaths (injuries to the abdomen, pelvis and, to some extent, the chest) constituted only 10%. This indicates head injury remains a major problem in our setting. Indeed, advances in trauma care across the globe have demonstrated a reduction in hospital trauma deaths due to hemorrhage but little change in death due to traumatic brain injury [17, 18]. Nonetheless, while primary brain injuries can only be mitigated by legislation and primary injury prevention measures, much can be done to prevent secondary brain injuries, such as targeted brain protection from hypoxia, hypercarbia and hypotension. These measures may improve survival in ICU deaths due to head injury, which is close to 50% in this study.

About 7% of the reported deaths in this study occurred in the ward. These were mainly elderly patients with extremity injuries and normal vital signs on arrival at the hospital. This reflects the high incidence of falls in old Emirati females with fractured neck femurs, as we have previously reported [19]. The median ED length of stay in these patients was the highest. The overall median ED length of stay was about two hours, which was close to double for those who died in the ward. Many studies have reported an increasing trend in trauma in the elderly [20–22]. We have also reported a similar trend in our setting [19]. Recognizing these high-risk patients will help focus on intervention measures such as preventing falls in the elderly and optimizing their care in the ED by reducing their ED length of stay and instituting measures to reduce injury complications.

There were significant differences in mortality rates in our trauma-receiving hospitals. Hospitals A and E each received over seven thousand trauma cases during the study period. This equates to more than 1000 trauma admissions per year. The two hospitals admitted close to 50% of all the trauma cases but accounted for only 25.8% of the total deaths. In contrast, three other hospitals received between three to five thousand cases representing 40% of the total trauma admission but accounted for almost 70% of the total deaths. This may be due to the differences in the setup at the different institutions and the trauma team development within each hospital. In addition, there were differences in the median ISS of the patients in the different hospitals, making further comparison difficult. Several studies have shown that the regionalization of trauma services leads to better patient outcomes by concentrating trauma resources and expertise in a few centers [23, 24]. The optimal annual trauma admissions that ensure a viable trauma centre with the maintenance of skills is unknown. However, it has been shown that volume leads to better outcomes in trauma care [24]. A system of hubs and spokes with agreed procedures with the EMS to bypass smaller hospitals and transfer trauma patients directly to the major trauma centres will ensure the maintenance of skills and improved patients' outcome.

About 75% of those who died in the ward received no trauma code or only had a consultation. This suggests a significant level of under-triaging. Our results show that the median (IQR) age for the patients who died on the ward was 65.50 (31.75–82.21), indicating that they were elderly trauma patients. Appropriate triaging of elderly trauma patients is challenging. The American College of Surgeons Committee on Trauma (ACS-CoT) adult triage tool performs poorly in this age group. Many triage tools that modify the physiological thresholds have been developed to improve triage reliability. Still, elderly trauma patients continued to experience significant levels of under-triaging with the attendant impact on outcomes [25–27]. Adopting any of these new elderly trauma triaging tools in our settings may improve outcomes in our population.

Limitations Of The Study

Our study has a number of limitations. There were no prehospital data for on-scene and transfer time. In addition, in some cases, the exact cause of death is unknown, as UAE law does not permit a post-mortem examination. It is also possible that some patients were treated in other small hospitals, but they were not captured in our study because there was no mortality recorded. Finally, we do not have the catchment population for each hospital as they overlap, so we combined hospitals on their regional distribution to calculate the annual incidence of hospitalized death.

Conclusions

Death from trauma predominantly affects young males in our setting. Motor traffic collisions and falls are the two leading causes. Over 85% of hospital deaths occurred in ICU and ED from head injuries and injuries affecting two body regions. Primary prevention of traffic accidents through legislation and enforcement can mitigate prehospital death, while secondary prevention targeting improved care in the ED and ICU will improve in-hospital mortality.

Abbreviations

AIS: Abbreviate Injury Scale

DOH: Department of health

ED: Emergency Department

EMS: Emergency Medical Services

GCS: Glasgow Coma Scale

ICU: Intensive care unit

IQR: Interquartile range

ISS: Injury Severity Score

NISS: New Injury Severity Score

RR: Respiratory rate

RTC: Road traffic collision

SBP: Systolic blood pressure

UAE: United Arab Emirates

Declarations

Contribution of authors: DOA had the idea, obtained the ethical approval and the data, coded the data, prepared the tables, and drafted the manuscript, AAC participated in the idea and helped in drafting the manuscript, FAZ participated in the idea, helped in coding the data, did the statistical analysis, drew the graphs, and wrote the results section. Critically read and edited the manuscript. All authors approved the last version of the paper.

Funding: There was no funding for this research study.

Availability of data and materials: There are no additional data available to share with the readers. Data can be shared with the Editor of the Journal if requested.

Ethics approval and consent to participate: The study was approved by the Department of Health (DOH) of the Abu Dhabi Emirate. (Ref: DOH/CVDC/2021/932). The patients or their caregivers gave their written informed consent to use their data for research.

Consent for publication: Not applicable

Competing interests: The authors declare that they have no competing interests.

Acknowledgements: We thank Ms Samira Mohammed Al Kathiri and Dr Amal Mubarak Madhi from the Environmental and Occupational Health and Safety Department, Abu Dhabi Public Health Center, Abu Dhabi, Mr Amer Faiz Rana and Mr Carl Edison Jr Manajero, Trauma Registrars at SSMC, and finally Mr Norman Avila, Trauma Program Manager SSMC and Abu Dhabi Central Registry Administrator for their help and support of this project.

References

1. World Health Organization: Injuries and Violence; Facts sheet 2021. Available at https://www.who.int/news-room/fact-sheets/detail/injuries-and-violence Accessed 10th February 2023
2. GDP per capita (Current US $: Available at https://data.worldbank.org/indicator/NY.GDP.PCAP.CD Accessed 10th February 2023
3. Abu Dhabi Statistics Year book 2020, Page 74–75. Available at https://www.scad.gov.ae/Release%20Documents/Statistical%20Yearbook%20of%20Abu%20Dhabi_2020_Annual_Yearly_en.pdf Accessed 12th February 2023
4. World Bank Data on injury deaths by Country. Available at https://www.who.int/data/gho/data/themes/mortality-and-global-health-estimates/ghe-leading-causes-of-death Accessed 10th February 2023

5. Hefny AF, Idris K, Eid HO, Abu-Zidan FM. Factors affecting mortality of critical care trauma patients. Afr Health Sci. 2013 Sep;13(3):731–5. doi: 10.4314/ahs.v13i3.30. PMID: 24250314; PMCID: PMC3824443.
6. Yasin YJ, Alao DO, Grivna M, Abu-Zidan FM. Impact of the COVID-19 Pandemic on road traffic collision injury patterns and severity in Al-Ain City, United Arab Emirates. World J Emerg Surg. 2021 Nov 19;16(1):57. doi: 10.1186/s13017-021-00401-z. PMID: 34798873; PMCID: PMC8602977.
7. Alao DO, Cevik AA, Eid HO, Jummani Z, Abu-Zidan FM. Trauma system developments reduce mortality in hospitalised trauma patients in Al-Ain City, United Arab Emirates, despite increased severity of injury. World J Emerg Surg. 2020 Aug 18;15(1):49. doi: 10.1186/s13017-020-00327-y. PMID: 32811505; PMCID: PMC7437038.
8. Abu Dhabi Health Statistics 2017. Available at file:///C:/Users/fabuz/Downloads/AbuDhabiHealthStatistics.pdf Accessed 10th February 2023
9. Statistics Year book Page 116. Available at https://scad.ae/Release%20Documents/SYB_2018_EN_9Sep%20_Chart%20Correction.pdf Accessed 10th February 2023
10. Oyeniyi BT, Fox EE, Scerbo M, Tomasek JS, Wade CE, Holcomb JB. Trends in 1029 trauma deaths at a level 1 trauma center: Impact of a bleeding control bundle of care. Injury. 2017 Jan;48(1):5–12. doi: 10.1016/j.injury.2016.10.037. Epub 2016 3rd November. PMID: 27847192; PMCID: PMC5193008.
11. Trunkey DD. Trauma. Accidental and intentional injuries account for more years of life lost in the US than cancer and heart disease. Among the prescribed remedies are improved preventive efforts, speedier surgery and further research. Sci Am. 1983 Aug;249(2):28–35. PMID: 6623052.
12. Trunkey DD. A time for decisions. Br J Surg. 1988 Oct;75(10):937-9. doi:10.1002/bjs.1800751002. PMID: 3219538.
13. El-Sadig M, Norman JN, Lloyd OL, Romilly P, Bener A. Road traffic accidents in the United Arab Emirates: trends of morbidity and mortality during 1977–1998. Accid Anal Prev. 2002 Jul;34(4):465 – 76. doi: 10.1016/s0001-4575(01)00044-6. PMID: 12067109.
14. Gunst M, Ghaemmaghami V, Gruszecki A, Urban J, Frankel H, Shafi S. Changing epidemiology of trauma deaths leads to a bimodal distribution. Proc (Bayl Univ Med Cent). 2010 Oct;23(4):349–54. doi: 10.1080/08998280.2010.11928649. PMID: 20944754; PMCID: PMC2943446.
15. Rauf R, von Matthey F, Croenlein M, Zyskowski M, van Griensven M, Biberthaler P, Lefering R, Huber-Wagner S; Section NIS of DGU. Changes in the temporal distribution of in-hospital mortality in severely injured patients-An analysis of the TraumaRegister DGU. PLoS One. 2019 Feb 22;14(2):e0212095. doi: 10.1371/journal.pone.0212095. PMID: 30794579; PMCID: PMC6386341.
16. Søreide K, Krüger AJ, Vårdal AL, Ellingsen CL, Søreide E, Lossius HM. Epidemiology and contemporary patterns of trauma deaths: changing place, similar pace, older face. World J Surg. 2007 Nov;31(11):2092 – 103. doi: 10.1007/s00268-007-9226-9. PMID: 17899256.
17. Jochems D, Leenen LPH, Hietbrink F, Houwert RM, van Wessem KJP. Increased reduction in exsanguination rates leaves brain injury as the only major cause of death in blunt trauma. Injury. 2018 Sep;49(9):1661–1667. doi: 10.1016/j.injury.2018.05.012. Epub 2018 23rd May. PMID: 29903577.
18. Dutton RP, Stansbury LG, Leone S, Kramer E, Hess JR, Scalea TM. Trauma mortality in mature trauma systems: are we doing better? An analysis of trauma mortality patterns, 1997–2008. J Trauma. 2010 Sep;69(3):620-6. doi: 10.1097/TA.0b013e3181bbfe2a. PMID: 20093983.
19. Alao DO, Cevik AA, Grivna M, Eid HO, Abu-Zidan FM. Epidemiological changes of geriatric trauma in the United Arab Emirates. Medicine (Baltimore). 2021 Jun 4;100(22):e26258. doi: 10.1097/MD.0000000000026258. PMID: 34087916; PMCID: PMC8183772.
20. Go KT, Cheng JY, Seah X, Goh MH, Teo LT, Cole E. The Changing Epidemiology of Serious Trauma in the Elderly Population: An Increasing Concern of a Tertiary Hospital in Singapore. Ann Acad Med Singap. 2019 Nov;48(11):354–362. PMID: 31960015.
21. American College of Surgeons. National Trauma Data Bank. Available at: https://www.facs.org/quality-programs/trauma/tqp/center-programs/ ntdb. Accessed on 10th February 2023.
22. Major trauma in elderly people: TARN report 2017. Available at: https://www.tarn.ac.uk/Content.aspx?c=3793 Accessed on 2nd February 2023.

23. Nicholl JP. Optimal use of resources for the treatment and prevention of injuries. Br Med Bull. 1999;55(4):713 – 25. doi: 10.1258/0007142991902736. PMID: 10746326.
24. Minei JP, Fabian TC, Guffey DM, Newgard CD, Bulger EM, Brasel KJ, Sperry JL, MacDonald RD. Increased trauma center volume is associated with improved survival after severe injury: results of a Resuscitation Outcomes Consortium study. Ann Surg. 2014 Sep;260(3):456–64; discussion 464-5. doi: 10.1097/SLA.0000000000000873. PMID: 25115421; PMCID: PMC4153990.
25. Fuller G, Pandor A, Essat M, Sabir L, Buckley-Woods H, Chatha H, Holt C, Keating S, Turner J. Diagnostic accuracy of prehospital triage tools for identifying major trauma in elderly injured patients: A systematic review. J Trauma Acute Care Surg. 2021 Feb 1;90(2):403–412. doi: 10.1097/TA.0000000000003039. PMID: 33502151.
26. Hoyle AC, Biant LC, Young M. Undertriage of the elderly major trauma patient continues in major trauma centre care: a retrospective cohort review. Emerg Med J. 2020 Aug;37(8):508–514. doi: 10.1136/emermed-2019-208541. Epub 2020 Jun 16. PMID: 32546474.
27. Alshibani A, Singler B, Conroy S. Towards improving prehospital triage for older trauma patients. Z Gerontol Geriatr. 2021 Mar;54(2):125–129. English. doi: 10.1007/s00391-021-01844-4. Epub 2021 28th January. PMID: 33507358

Figures

Figure 1

A map showing the locations of the seven contributing hospitals to the Abu Dhabi Trauma Registry in Abu Dhabi Emirate, United Arab Emirates during the period of 2014-2019.

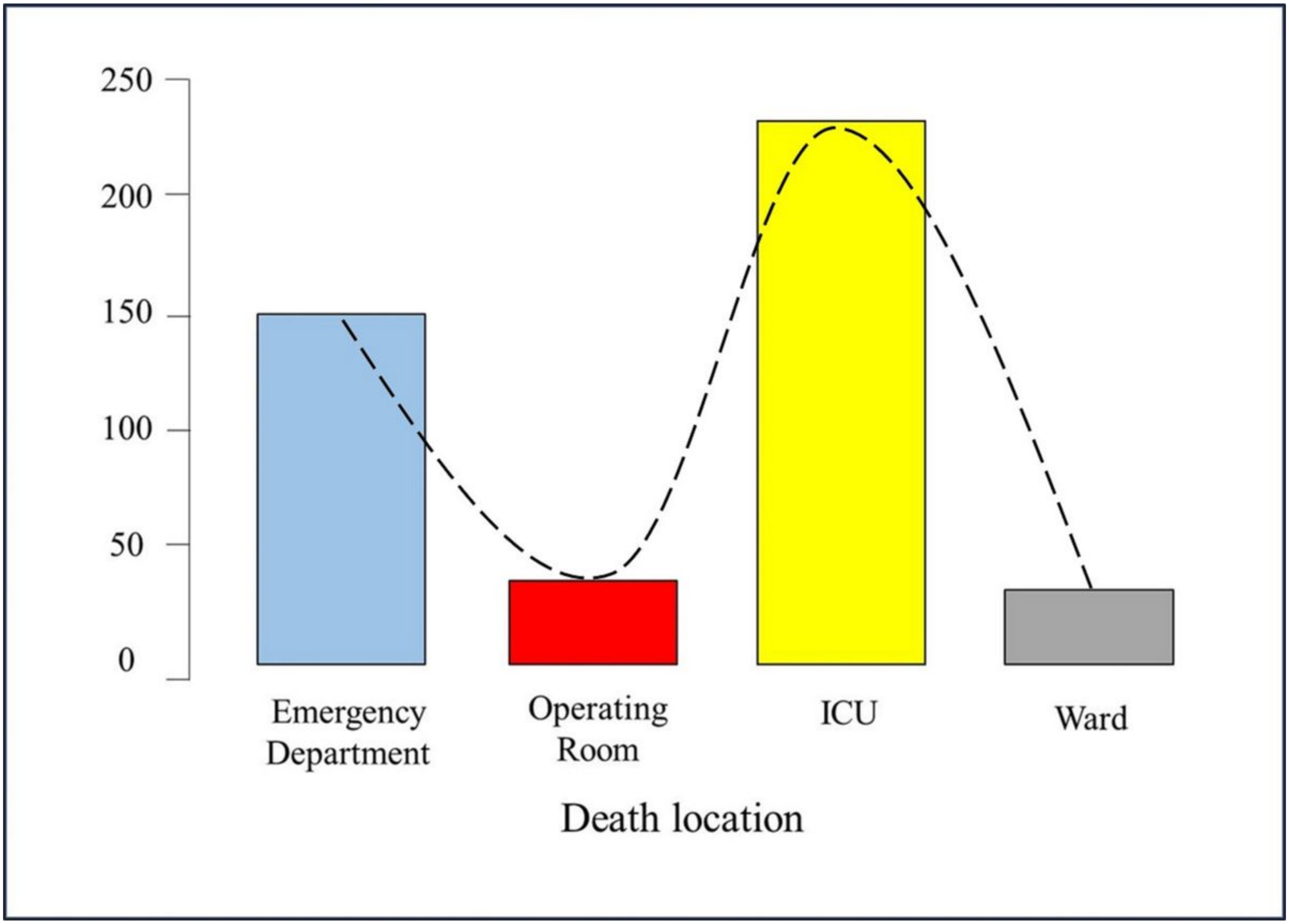

Figure 2

Bar chart of the location of death of hospitalised trauma patients in the Emirate of Abu Dhabi, United Arab Emirates during the period of January 2014 to December 2019, n=453 according to the Abu Dhabi Emirate Trauma Registry.

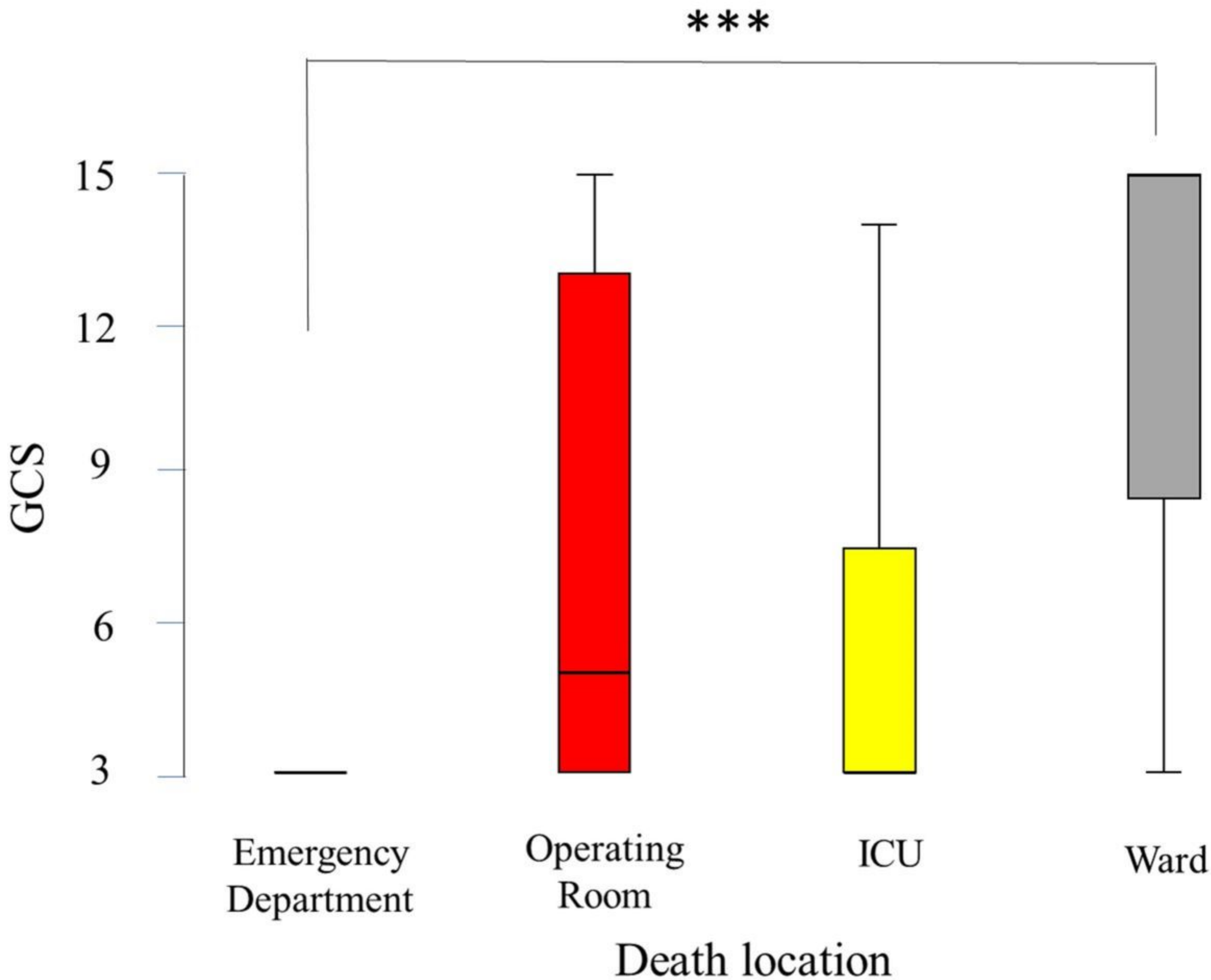

Figure 3

Box-and-whisker plot of Glasgow Coma Scale (GCS) of the hospitalised trauma patients in the Emirate of Abu Dhabi, United Arab Emirates by location of death, who died during the period of January 2014 to December 2019, n=453, according to the Abu Dhabi Emirate Trauma Registry. The box represents the 25th to the 75th percentile IQR. The horizontal line within each box represents the median. ***$p < 0.001$, Kruskal-Wallis test.

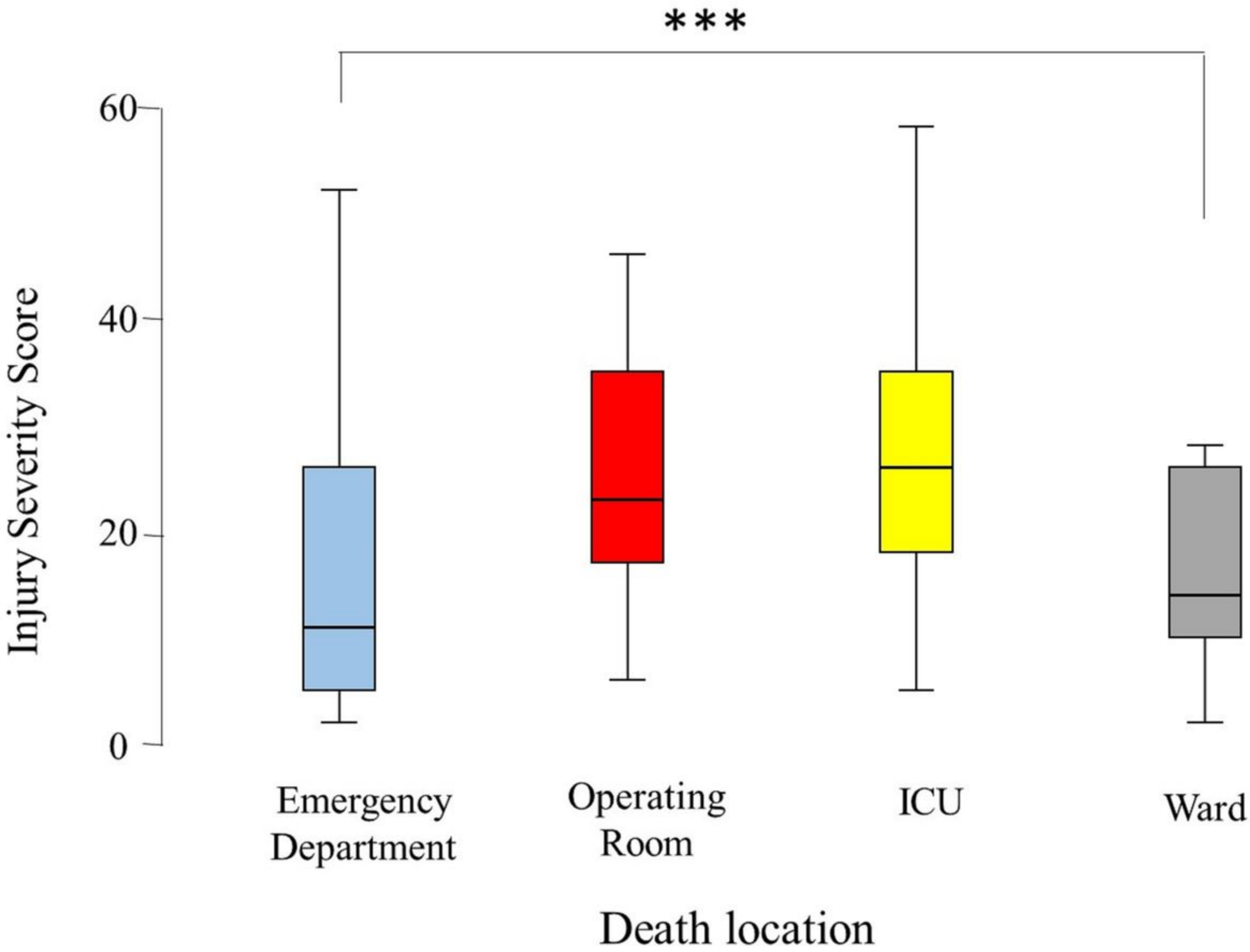

Figure 4

Box-and-whisker plot of Injury Severity Score of the hospitalised trauma patients in the Emirate of Abu Dhabi, United Arab Emirates by location of death, who died during the period of January 2014 to December 2019, n=453, according to the Abu Dhabi Emirate Trauma Registry. The box represents the 25th to the 75th percentile IQR. The horizontal line within each box represents the median. ***$p < 0.001$, Kruskal-Wallis test.

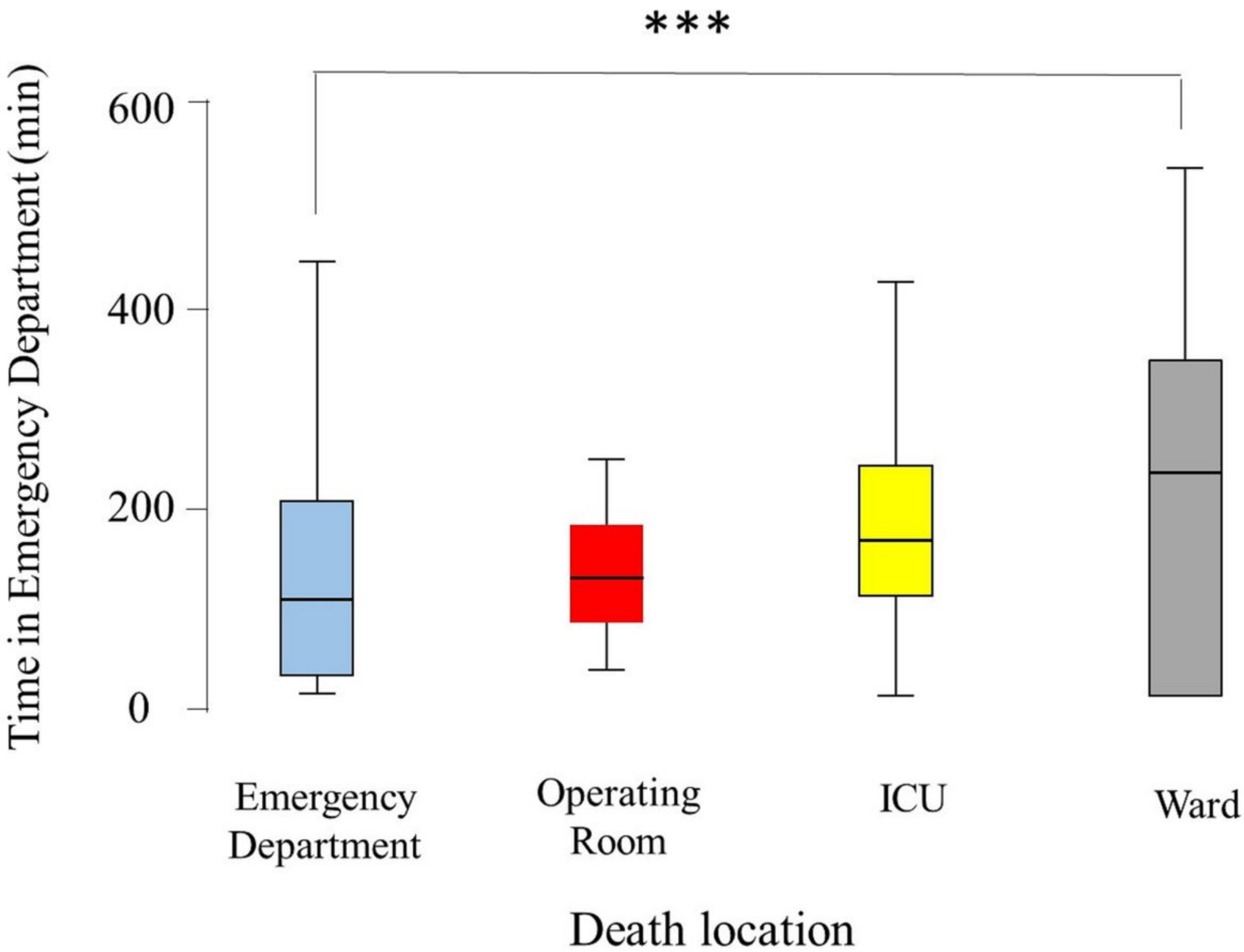

Figure 5

Box-and-whisker plot of time in the Emergency Department in minutes of the hospitalised trauma patients in the Emirate of Abu Dhabi, United Arab Emirates by location of death, who died during the period of January 2014 to December 2019, n=453, according to the Abu Dhabi Emirate Trauma Registry. The box represents the 25th to the 75th percentile IQR. The horizontal line within each box represents the median. ***p < 0.001, Kruskal-Wallis test.

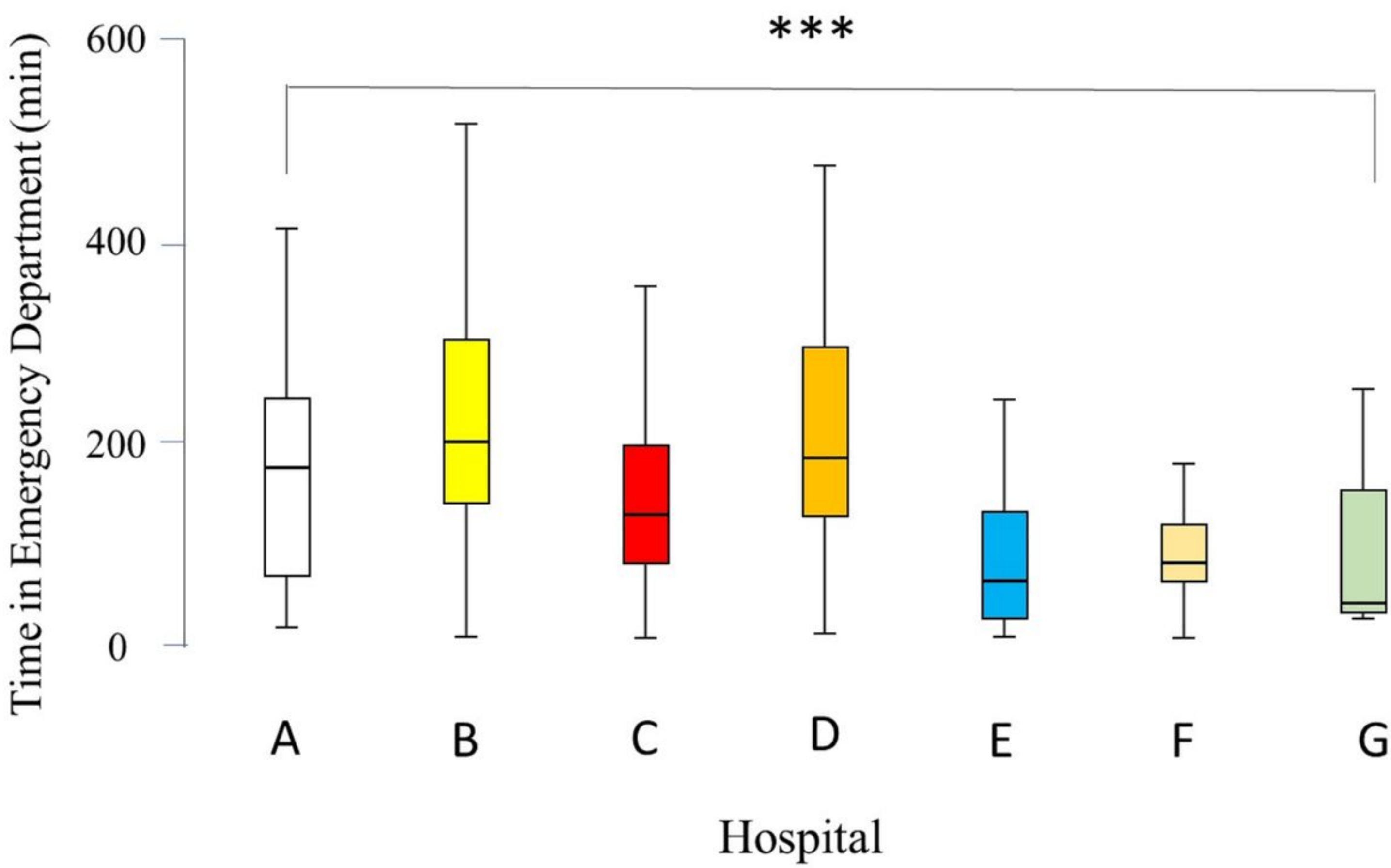

Figure 6

Box-and-whisker plot of time in the Emergency Department in minutes of the hospitalised trauma patients in the Emirate of Abu Dhabi, United Arab Emirates by treating hospital, who died during the period of January 2014 to December 2019, n=453, according to the Abu Dhabi Emirate Trauma Registry. The box represents the 25th to the 75th percentile IQR. The horizontal line within each box represents the median. ***p < 0.001, Kruskal-Wallis test.