ORIGINAL ARTICLE

Trauma intensive care in a terror-ravaged, resource-constrained setting: Are we prepared for the emerging challenge?

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ABSTRACT

Introduction: Trauma in developing countries has been on the increase, a situation perpetuated by rising road traffic collisions, terrorism and firearms proliferation. Some of the victims of trauma are left with life threatening conditions requiring urgent surgical intervention and/or intensive care. The objectives of this study were to determine the pattern of major trauma needing intensive care in the region, and to determine the outcome of major trauma admitted to intensive care unit.

Methods: A six-year retrospective cohort study of trauma patients needing intensive care, set in the Intensive Care Unit of Ahmadu Bello University Teaching Hospital, Zaria, North-West Nigeria. Subjects were major trauma patients admitted into the intensive care unit of the institution, identified via an admission register kept in the unit. The main outcomes measured were length of stay and mortality.

Results: Trauma admissions represented 25.1% of the all intensive care admissions. Severe traumatic brain injury accounted for 32.1% of the trauma admissions, while burns accounted for 23.2%. Of the injuries, 15.5% were sustained in bomb blasts, and 8.3% were firearm injuries. The majority of the patients stayed for no more than seven days from admission. Burns patients had the worst outcomes, with 82.1% mortality.

Conclusion: Major trauma contributes significantly to local intensive care admissions, with terrorism- related trauma now an emerging challenging cause of major trauma in our region. The observed poor outcomes in this study are a reflection of the quality of available intensive care, and lends credence to the concept of appropriately resourced, specialised intensive care units for optimisation of care.

African relevance

- Major trauma is a leading cause of intensive care admissions in North-West Nigeria.
- Terrorism-related trauma is an emerging challenge in this region.
- Improved quality of trauma intensive care is an urgent concern due to increasing trauma-related mortality and morbidity, and poor outcomes.

Introduction

Trauma has remained a public health menace globally, especially in developing countries like Nigeria where the incidence has been on the increase [1,2]. Globally, trauma injuries are estimated to cause 9% of deaths annually and accounts for 11% of global disability-adjusted life years (DALYs) [3] – road traffic collision account for 60% of the DALYs [4]. The burden of global trauma is heavier in low- and middle-income countries (LMICs), which are coincidentally also the countries least equipped to handle such a load, resulting in mortality rates ranging between 55% and 63% [5–7]. Road traffic collision-related injuries have been the leading cause of trauma admissions and mortality in these countries – accounting for between 30% and 86% of trauma admissions [8].

In the last one and half decades, the African continent has witnessed a increased trend of in armed conflicts, especially terrorism – fuelled by political, ethnic and religious factors – that has proven difficult to contain [9]. Previously, acts of terrorism were mainly isolated to South-East Asia and the Middle-East. In sub-Saharan Africa, Somalia and Nigeria are the worst affected. Terror attacks may take the form of car bomb explosions, suicide bomber explosions, and gunshots from unknown gunmen. This usually results in multiple casualties, with severe

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injuries, often leaving victims with life threatening emergencies that require urgent surgical intervention and/or intensive care [10,11]. Thus, trauma remains a major cause of intensive care admissions, and proves to be a heavy health care burden, both on the part of health care providers and their patients [12].

The intensive care unit (ICU) of a hospital provides high level care and life support for critically ill or injured patients. It has sophisticated life support facilities and trained personnel, which is not present on an ordinary ward [13,14]. The ICU services of a good hospital are said to take about 15%–20% of the hospital budgets [15]. Thus, a significant proportion of the resources of any hospital is expended on the ICU in order to provide much needed critical care, which consequently puts a high financial strain on the resources of any hospital, especially in resource-constrained settings like ours, necessitating judicious use of scarce resources.

Despite the increasing trend in major trauma requiring intensive care admissions in LMICs (like ours), the ICUs of most hospitals are neither expanding, nor improving in facilities and trained personnel to match the increasing trauma rate. This results in either denial of ICU admissions for deserving critically injured patients (due to limited space), or poor outcomes for those who get admitted [16,17]. An appraisal of ICU trauma patients and their admission outcomes is important in characterizing major trauma trends and planning interventions that will improve their ICU outcome as well as preventing their occurrence and subsequent ICU admission need.

We conducted an audit of the trauma admissions into the ICU at our institution with the aim of determining the trauma profile and outcome, hoping the findings will help in appropriate policy formulation and optimization of the use of scarce healthcare resources that will improve the outcome of our trauma ICU patients. The objectives of this audit were to determine the pattern of major trauma needing intensive care in our region, and to determine the outcome of major trauma in our ICU.

Methods

A six-year (June 2009 and May 2015) retrospective cohort audit of trauma patients that required critical care in the ICU of Ahmadu Bello University Teaching Hospital, Zaria, North-West Nigeria (Fig. 1). The hospital has about 1000 bed capacity and is located in a semi-urban town in the North-Western part of Nigeria, which also had its share of the Boko Haram terrorist activity, and serves as a referral centre to the adjoining states of the North-Western and North-Central parts of Nigeria. The hospital has an eight-bed multi-disciplinary ICU, three of which are dedicated to burns patients care, and is run by the department of anaesthesiology and trained ICU nurses. During the study, the ICU had four ventilators, of which only one was operational. The other three were in a poor condition. The ICU also had four functioning multi-parameter monitors and one functioning defibrillator. Trauma patients admitted into the ICU usually come from the emergency centre, operating theatre and wards. Others come from referrals from peripheral hospitals.

The emergency centre receives all types of emergencies with the exception of obstetrics and paediatric medical emergencies. Clinically, it is headed by a consultant orthopaedic surgeon and staffed by medical officers and resident doctors from various clinical specialties on their emergency medicine rotation (each taking 24-h calls for their respective specialties). There are no specialist trauma surgeons or emergency physicians. Instead there are seven general surgeons with individual interests ranging from gastro-intestinal, breast and endocrine, hepatobiliary surgery and surgical oncology. In addition there are six orthopaedic surgeons, two plastic/reconstruction surgeons, two cardio-thoracic surgeons, four urologists, four maxillo-facial surgeons, and one neurosurgeon. There is no vascular surgeon, however the cardiothoracic surgeons undertake some vascular surgery within the limit of their capability. Nursing-wise, there are only two emergency care trained nurses amongst the ED nursing staff

Fig. 1. Ahmadu Bello University Teaching Hospital, Zaria, North-West Nigeria (*source:* www.mapsopensouce.com).

who run 6-h shift duties for morning and afternoon shift duties, and 12-h night shift duty. The emergency centre has 24-h access to a collocated double suite emergency theatre for emergency surgical procedures. The emergency centre also has a dedicated radiography machine, while the main radiology department has ultrasound, Computed Tomography, and Magnetic Resonance Imaging capability. The laboratory operates during office hours from Monday to Friday, and is on call outside the normal working hours. There is a 24-h emergency pharmacy collocated to the emergency centre. There are no prehospital emergency care service within our region.

Subjects were all severely injured patients admitted into the ICU of our institution and identified from the admission register kept in the unit, irrespective of the cause of injury. Through this, 175 patients were identified out of a total of 696 ICU admissions during the period of study. The case notes of identified trauma patients were retrieved and information regarding their demography, nature of injury, aetiology of injury, interventions, source of admission, length of stay and outcome were collated by two of the researchers and kept in a computer. Patients with missing case notes or incomplete data in the case note were excluded. So were injuries from poisoning.

Data was analysed with Statistical Package for Social Sciences (SPSS) version 20.0 and presented in tables and chart. Ethical approval for the study was obtained from the Health Research Ethics Committee of our institution.

Results

A total of 175 trauma admissions were admitted to our ICU, out of total ICU admissions of 696, representing 25.1% of the total ICU admissions during the period under study. Only 168 case notes (96.0%) were retrieved and reviewed. There were 142 (84.5%) males and 26 (15.5%) females, giving a male to female ratio of 5.5:1. The mean age was 35.3 years (ranging between two years to 72 years). Patients less than 45 years of age accounted for 124 (73.8%) of the admissions (Table 1).

Trauma admissions were predominantly from the emergency centre (n = 160, 95.2 %). Admissions from the operating theatre (n = 5, 3%) and referrals (n = 3, 1.8%) comprised the remaining. One hundred and one (60.1%) of the patients sustained their injuries in road traffic crashes, while 26 (15.5%) of the admissions were as a result of injuries sustained in bomb blasts, and 14 (8.3%) were gunshot injuries, among others (Table 2). Vehicular crashes accounted for 65 (64.4%) of the road traffic crashes, while motorcycle crashes accounted for 28.7% (Fig. 2).

Severe traumatic brain injury with or without other associated lesser injuries was the most common reason for admission, accounting for 54 (32.1%) of the admissions, while major burns with or without an inhalational component accounted for 39 (23.2%) admissions, and 26 (15.5%) were admitted for polytrauma without brain injury (Table 3).

The admission Glasgow coma scores of all trauma patients who presented with impaired consciousness are given in Fig. 3. The frequency of injuries affecting major body regions are given in Fig. 4.

Among the burns patients, 18 (46.2%) were caused by bomb blasts. Other causes were petrol tanker/storage container explosions (28.2%), domestic fire accidents (20.5%) and electrical current (5.1%) (Table 4). Seven patients had ICU interventions (five had endotracheal intubation and mechanical ventilation, two had tracheostomy and intubation).

A substantial proportion of patients (42.9%) stayed for less than

Table 1
Admission by age.

Age	Number (n)	Percent (%)
< 15	22	13.1
15–29	47	28.0
30–44	55	32.7
45–54	28	16.7
60–74	16	9.5

Table 2
Admission by aetiology of injury.

Aetiology	Number (n)	Percent (%)
Road traffic crashes	101	60.1
Gunshots	14	8.3
Bomb blast	26	15.5
Petrol explosion	8	4.8
Collapsed objects	1	0.6
Fall from height	3	1.8
Assaults	5	3.0
Electrical current	2	1.2
Domestic fire	8	4.8

four days; the majority (n = 126, 75.0%) stayed for not more than seven days on admission and most of them ended in mortality. Burns patients had the worst outcome with 138 (82.1%) ending in mortality - the least burnt admission had 43.5% estimated burns surface area. This was followed by traumatic brain injured patients (n = 112, 66.7%); while penetrating injuries to the torso with visceral involvement had the best outcome (n = 110, 65.4%), followed by patients with blunt injuries to the torso with visceral injuries (n = 103, 61.5%) (Table 5).

Discussion

Nigeria, especially the northern region, is under siege by the Boko Haram insurgents [9]. Terrorist acts are now part of the fears of the inhabitants of this region as they go out for their daily activities. This has compounded an already difficult situation created by the rising trauma load caused by road traffic collisions due to poor roads [8]. Unfortunately, not much is done to address the deficiencies in the Nigerian emergency health care system to cater for the severely injured victims of such trauma. Most public health facilities are poorly equipped and staffed, no national policy exists on pre-hospital trauma care, and intensive care medical units are neglected – an area that requires significant resources for optimum services.

Major trauma constituted a quarter of ICU admissions in this review. This is lower than that reported by Olajumoke et al. [18] and Adenekan et al. [19] in south-western Nigeria, and Chalya et al. [20] in north-western Tanzania. The limited ICU facilities available to meet the needs of the growing number of severely traumatized patients in our region could be responsible for this relatively low proportion, as some of these patients will be denied the critical care they deserve until such facility becomes available for use. Our ICU has only one functional ventilator, and four functional multi-parameter monitors for eight beds. The extent of urbanization of the town in which our hospital is located is another factor. Our hospital is located in a sub-urban area.

Most of our trauma admissions were young males, like most other studies [18–20]. It is unfortunate that the economically productive age group of our society is most affected. The male predominance may be because males are the bread winners in most families and therefore are often on the move in their bid to fend for their families. They were, however, older than those reported by Chalya et al. [20] in north-western Tanzania, but comparable to those reported by Olajumoke et al. [18] and Adenekan et al. [19] in south-western Nigeria.

Severe traumatic brain injury with or without other lesser injuries was the most common reason for admission. This is similar to the finding in other studies within and outside sub-Saharan Africa [18–22]. Most of such injuries are sustained in road traffic crashes as was also revealed by our study. This may be due to poor compliance with road safety rules, especially regarding the use of the seat-belt. Compliance with seat-belt use in our country has been shown to be poor, with seat-belt use rate of 16%−52% reported, compared to the 97% compliance rate recorded in Scotland [23,24].

Like most other studies [8,18–22], road traffic crashes were the most common cause of our trauma ICU admissions. This could be a
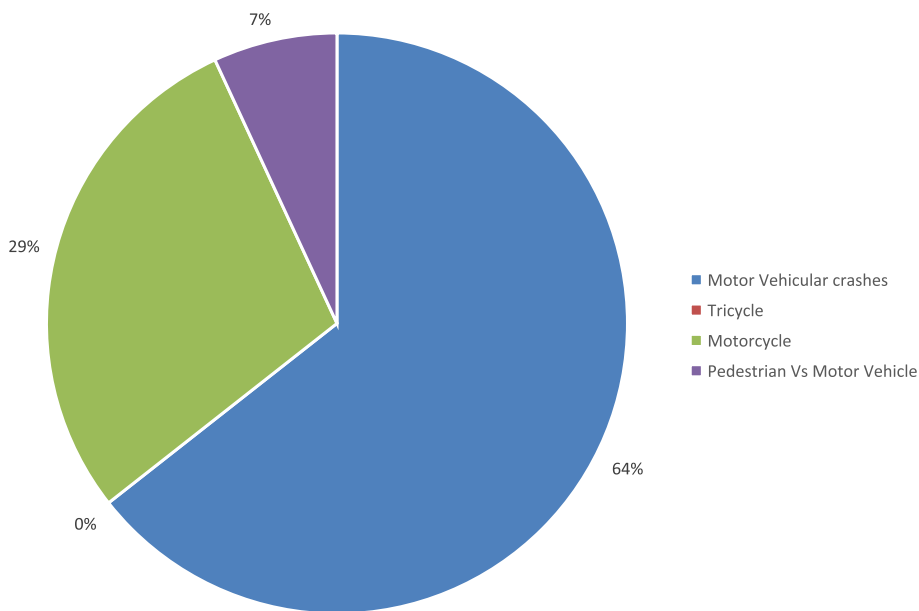
Fig. 2. Different types of road traffic collisions.

Table 3

Types of injuries.

Injury	Number (n)	Percent (%)
Severe traumatic brain injury with or without other less severe injuries	54	32.1
Burns with or without inhalational injuries	39	23.2
Penetrating injuries to the torso with visceral injuries	26	15.5
Penetrating skull injury with evisceration of brain tissue	3	1.8
Blunt injuries to the torso with visceral injuries	13	7.7
Complete spinal cord injuries	5	3.0
Fractures with cardiopulmonary complications	3	1.8
Polytrauma involving combinations of the above injuries without brain injury	25	14.9

reflection of the poor state of our roads, as well as over-dependence on road transportation in developing countries like ours, where rail transport system is virtually moribund, and air transport where available, cannot be afforded by most of the travellers.

Of the road traffic crashes, vehicular crashes accounted for more than half of the crashes. This is in contrast to that reported by Chalya et al. [20] in Tanzania and Tan et al. [22] in Singapore, where motorcycle crashes accounted for more than half of their road traffic crashes. This difference may be due to the ban on use of motorcycle as a means of public transportation in most of our cities, as well as their prohibition from plying some major roads even without passengers some years back. Another factor to the reduction of motorcycle crashes in our region may be the enactment of a law that makes it compulsory for motorcyclists to use crash helmets. A third reason could be due to a stricter enforcement of the road safety laws that concerns the motorcyclists and their passengers by the
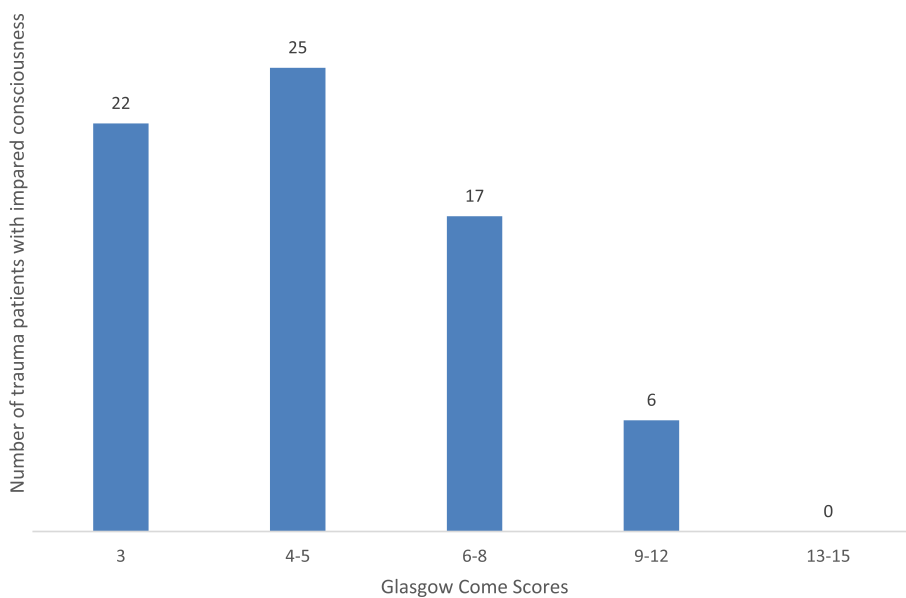

Fig. 3. Admission Glasgow Coma Scores (GCS) of all trauma patients with impaired consciousness.
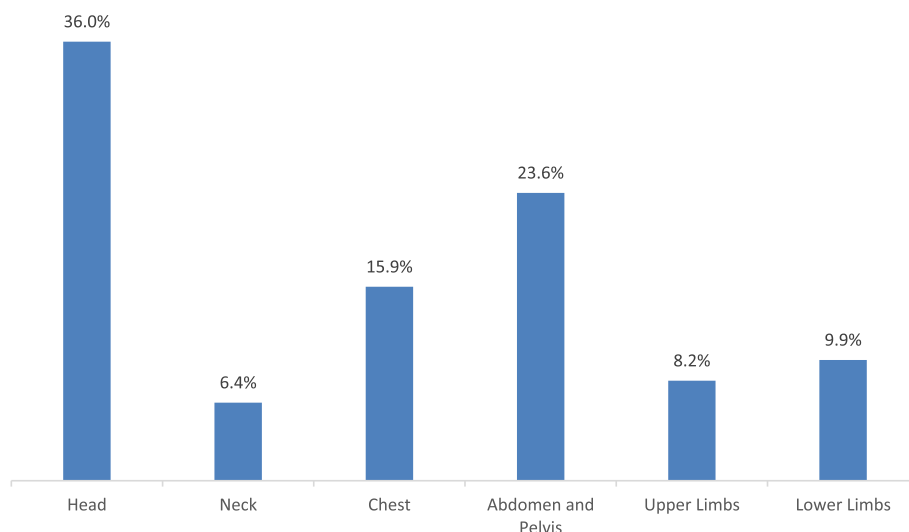
Fig. 4. Injuries by major body region.

Table 4
Causes of burns injuries amongst ICU admissions.

Causes	Number (n)	Percent (%)
Bomb Blast	18	46.2
Petrol Tanker/Storage Container Explosion	11	28.2
Domestic Accidents	8	20.5
Electric Burns	2	5.1

enforcement agencies, probably because motorcyclists are found more in the cities where they can be easily arrested when flouting these laws, unlike vehicle drivers and their passengers whose crashes occur commonly on the highways outside the cities where the enforcement agents are sparsely found, hence they flout most of the road safety laws with impunity which often lead to crashes.

Burns were the second most common reason for admission in our study, accounting for 23.2%. This is similar to that reported by Adenekan [19] in another Nigerian study. Most of our ICU burns patients sustained their burns in bomb blasts during terrorist attacks in places of worship and other public places. Such terrorist acts are becoming frequent in our country as a result of the Boko Haram insurgency that has proven difficult to contain. The attacks take the form of explosions from improvised explosive device (IED) laden cars, and suicide bombings, resulting in mass casualties with severe injuries, most of which are life-threatening. Petrol tanker/storage container explosions were the second most common cause of burns in our series. It may be inferred that in peace time, petrol tanker/storage container explosion is probably the commonest cause of major burns requiring ICU

admission in our region. This is as a result of poor handling of petroleum products by the black marketers, most of whom store these products in their residences in gallons. This habit is compounded by our epileptic power supply that has forced almost every small-scale business owner and household to acquire a small electricity generating set, with some of them storing fuel in small containers at their business premises and residences [19]. Also, some of these petroleum products are adulterated, especially during scarcity, and lead to domestic fire accidents resulting in burns as recorded in our study. The proportion of burns in this study contrast with that reported by Chalya et al. [20] in Tanzania, where burns accounted for just nice percent of their series.

Most of the mortalities in our study occurred within the first four days of admission, while the survivors had longer stay. In fact, patients who survived the first seven days had higher chances of survival. This is in line with the findings of other studies in sub-Saharan Africa [18–20], but in contrast to reports in studies done in developed countries which reported longer stay by non-survivors [25,26]. This difference may be due to some factors like poor pre-hospital care and lack of emergency medical services in developing countries. The absence of rapid response ambulance services with trained personnel in most developing countries like ours even in the face of increasing terrorism, leaves our trauma patients at the mercy of sympathizers and relatives who transport them in all sorts of vehicles in awkward positions with resuscitation and care delayed until arrival in the hospital, when otherwise rescuable organ damage has already occurred. Available ambulances are mere transport vehicle for corpses. Another factor that maybe responsible for early mortalities amongst our trauma patients is lack of adequate life support equipment and trained personnel in our ICUs. Lastly, the differences in injury severity is another factor that may have

Table 5
Length of stay and outcome for the various injuries.

Length of stay	Day 1–3		Day 4–7		Day 8–14		Day 15–21		Day 22–28		> 28 days	
Injury/outcome	Alive	Death	Alive	Death	Alive	Death	Alive	Death	Alive	Death	Alive	Death
Traumatic brain injury	1 (1.9%)	17 (31.5%)	3 (5.6%)	14 (25.9%)	8 (14.8%)	5 (9.3%)	2 (3.7%)	–	2 (3.7%)	–	2 (3.7%)	–
Burns	–	21 (53.8%)	3 (7.7%)	8 (20.5%)	–	2 (5.1%)	–	–	1 (2.6%)	1 (2.6%)	–	–
Polytrauma	1 (4%)	8 (32%)	1 (4%)	7 (28%)	6 (24%)	–	–	1 (4%)	1 (2.6%)	1 (4%)	–	–
Blunt torso trauma	4 (30.8%)	2 (15.4%)	2 (15.4%)	3 (23.1%)	2 (15.4%)	–	–	–	–	–	–	–
Penetrating torso trauma	4 (15.4%)	6 (23.1%)	9 (34.6%)	2 (7.7%)	4 (15.4%)	–	–	–	–	1 (3.8%)	–	–
Penetrating skull injury	–	3 (100%)	–	–	–	–	–	–	–	–	–	–
Fractures with cardiopulmonary complications	–	3 (100%)	–	–	–	–	–	–	–	–	–	–
Spinal trauma	1 (20%)	2 (40%)	–	1 (20%)	–	1 (20%)	–	–	–	–	–	–

contributed to the differences in our outcome, though no trauma scoring was done for all our patients due to unavailability of the requisite clinical data in the case notes studied to calculate this, being a retrospective study.

Mortality was over two-thirds of trauma admissions to our ICU. This is comparable to the 53.2% reported by Adenekan et al. [19] in South-western Nigeria, but significantly higher than the 32.7% reported by Chalya et al. [20]in Tanzania and 26.4% by Mitchell et al. [27] in Jamaica. Mortality was highest amongst burns patients (82.1%), followed by patients with traumatic brain injury (66.7%). It is unfortunate that while mortalities from burns is declining globally, it remains a significant contributor of mortality in our country [28]. Even though no trauma score was used to compare their injury severity, it may be attributed to the severity of their injuries, as a significant number of the burns patients had inhalational components. Another observed factor that may have contributed to the very poor outcome amongst our burns patients is how they are nursed in open three-bed rooms without cross ventilation within our ICU, which encourages cross infection, instead of in separate cubicles with cross ventilation, or better still in a separate burns unit [29,30]. The unimpressive outcome recorded in this study, particularly amongst the burns patients, most of who sustained their injuries from explosions in a mass casualty scenario, and traumatic brain injured patients, lends credence to the need for implementation of a comprehensive trauma system including prehospital and emergency care with good ICU care anchored on well trained personnel and equipment in our region, especially in the face of increasing terrorism in our region.

A limitation of this study is the unavailability of any validated trauma score for any of the patients, which would have enabled us to objectively compare the outcome of the various trauma recorded in our study, as well as other studies elsewhere. This is due to the absence of the clinical parameters required for such estimation in most case notes studied.

Conclusion

Major trauma contributes a significant proportion of our ICU admissions. Road traffic crash is the leading cause, but with terror-related trauma emerging as a challenging cause of major trauma in our region. The poor outcome observed in this study can be improved by establishing a comprehensive trauma system. This should include prehospital and emergency trauma care backed up by reliable ICU care – none of which is currently available in our region. Naturally this would necessitate better funding of emergency trauma care services, which is challenging due existing meagre resources.

Conflict of interest

The authors declare no conflict of interest.

Dissemination of results

The results were presented to the ICU staff at Ahmadu Bello University Teaching Hospital. It was also presented to the Nigerian Orthopaedic Association at their 2017 annual general meeting. The paper has been translated by the authors to French and is available as a data supplement (Appendix A).

Author contributions

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: KA contributed 40%, ID 10%, US 20%, FE 5%, AI 20%, and MM 5%. All authors agree to be accountable for all aspects of the work in ensuring that any questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.afjem.2018.12.007.

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