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COMMENTARY

Trauma provision in South-West Nigeria: Epidemiology, challenges and priorities

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ABSTRACT

Trauma is a crucial public health problem that has been overlooked by developing countries including Nigeria. It has led to a worsening trauma trend as recent data suggests. The South-West Region of Nigeria remains one of the regions with the most injury prevalence. Since the introduction of the trauma system over half a century ago, regionalised trauma systems have become increasingly effective in changing the dynamics of trauma care and outcomes. However, similar to most developing countries trauma system is yet to be established in any region in Nigeria. This is also met by a lack of a centralised trauma registry, poor implementation of primary prevention practices, an informal prehospital care system, and poorly organised in-hospital care for trauma victims. Reversing these challenges could be a propelling force to the revolution of trauma provision in the region and extension to the nation, Africa, and other developing countries. Nevertheless, the stakeholders such as the government, legislature, Non-Governmental-Organisations, law-enforcement agencies, healthcare institutions, trauma experts, and the public have a huge role.

Introduction

Trauma is a neglected public health crisis especially in Low-Middle income countries (LMIC) [1]. These countries contribute the majority of the global burden of trauma. Data from the World Health Organisation (WHO) revealed that about 90% of the 4.4 million trauma-related deaths each year occur in LMIC [2]. In spite of this alarming report, most developing countries have maintained status quo or worsening trauma indices [3]. Nigeria is not excluded as the National Bureau of Statistics reported an increase in road traffic crashes (RTC) by approximately 14% from 2013 to 2019 [4].

In contrast, developed countries have shown advances in trauma care and improvement in the outcomes of trauma victims. Crucial to the achievement of an improved trauma outcome is the introduction and development of a trauma system (TS) [5]. TS provides a structural and functional framework for the care of injured patients from an injury scene through appropriate healthcare facilities [6]. All designated trauma facilities are more efficiently utilised in a regionalised trauma system (RTS) [7]. In the same vein, RTS has been proven to be economical and can result in a rapid trauma response, adequate prehospital-care services, reduced transit time, improved in-hospital standard of care, and a remarkable reduction in preventable deaths and permanent disability post-trauma [8,9].

Similar to other developing countries, the non-existence of TS in Nigeria among other challenges remains a huge setback to trauma provision [3]. Additionally, there is the problem of no centralised trauma registries, poor implementation of primary prevention practices, inadequate prehospital-care system, and in-hospital care [10,11]. These among other factors have contributed to a worsening trend in trauma morbidity and mortality within the country.

The South-West (SW) region, being one of the worst-hit regions, could be the pacesetter of modern trauma care in the country [12]. Changing the narrative would require genuine support and commitment from the government, legislature, Non-Governmental-Organisations, law-enforcement agencies, healthcare institutions, trauma experts, and the public.

Epidemiology

Nigeria is a multicultural diverse nation located in Sub-Saharan Africa with six geopolitical zones/regions [13]. The South-West (SW) region, dominated by the Yoruba tribe, consists of six states (Lagos, Oyo, Ogun, Osun, Ondo, and Ekiti) and makes up about a fifth of the Nigerian population with 32,500,000 people [14].

Just like most regions of the LMIC, Nigeria has no centralised database for trauma [15]. Data relating to injuries can be found in the hospital registries, the quarterly Federal Road Safety Commission

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(FRSC) and National Bureau of Statistics (NBS) report [4]. In these registries, RTC is the most reported form of injury.

Since 2015, there has been a growing trend of RTC rising by 3.82% in 2018 and 13.66% in 2019 [16]. The NBS in 2019 reported 11,072 RTC and 5,483 fatalities. The SW region has the highest proportion of fatal cases(25%) and contributes to most of the RTC burden(22%) [4].

The majority of RTC affect adults in the third and fourth decades of life [12]. The sex distribution is predominantly male [11,16]. This is because they are mostly traders or businessmen who more often travel for work and therefore spend more time driving, increasing their risk of accidents. The most vulnerable road users are the motor-vehicle passengers, motorcyclists, tricycle passengers, bicycles, and pedestrians in decreasing order [12,15]. Speed violation and loss of vehicular control are the two most common human risk factors while driving under alcohol influence and using phone on steering contribute the least [12].

Solagberu et al [17] reported that trauma victims were transported by relatives(52.83%), bystanders(6.74%), and law-enforcement agencies e.g. police officers(40.42%). Furthermore, the mode of transportation of these victims is mainly cars and buses(76.2%). Only 8% of victims were transported by an ambulance [18].

Several studies in this region showed that trauma is the leading cause of presentation, mortality, and morbidity in emergency centres in this region [19]. The majority of the injuries pattern seen was laceration and fracture [15]. Head injuries and multiple body injuries are the most common aetiology of trauma-related deaths [19].

Potential benefits of a regionalised trauma system

In 1966, the National Academy of Sciences and the National Research Council redefined injury as a “preventable and treatable disease” [20]. This redefinition was a catalyst to the establishment and rapid expansion of TS in most developed countries [5]. In the early stages, TS was developed as an exclusive system that manages injured patients in highly specialised tertiary or quaternary trauma centers [21]. Subsequently, it revolutionised to an inclusive system with the capacity and ability to achieve optimal injury control within a given population through the participation of all designated trauma centres within their capabilities and resource availability [22]. In Ohio, He et al [7] observed that the establishment of an inclusive regional TS was associated with improved utilisation of lower-level trauma centres.

A Regionalised trauma system (RTS) involves an integrated collaboration of institutions, agencies, and multidisciplinary teams to tackle injury as a disease from effective prevention to rehabilitation and successful societal reintegration of injury survivors [23]. It provides a structural framework, organised, and comprehensive approach for the management of a trauma victim from injury scene to surgical care within a defined geographical area [6]. Defining the geographical area involved enables TS to focus on trauma needs while maximising the available resources within the region. In England, the National Hospital Service (NHS) created several regional trauma networks following the National Confidential Enquiry into Patient Outcome and Death (NCEPOD) report 2007 [24] that identified poor outcomes in the organisation of trauma care. A review of the changed system ten years later by Moran et al [25] demonstrated that the development of the regional TS was associated with an increased patient flow, efficient consultant-led care, and a significant increase(19%) in the probability of survival of trauma patients.

Evidence further supports that RTS has led to remarkable improvements in trauma care and outcomes [26]. A national study in the United States of America (US) [27] showed up to one-quarter(25%) lower risk of death for in-hospital, 30-day, and 90-day mortality if trauma victims received care in a regional TS. In the above study, major trauma patients, defined as Injury Severity Score (ISS)>15 received the most benefit. This category has potentially life-threatening injuries which require the expertise and capacity of a major trauma centre to increase survival.

RTS also has a significant positive impact on trauma-associated morbidities and functional outcomes [9]. Nirula and Karen found that TS leads to a better functional capacity especially among trauma victims with penetrating injuries [28]. In addition, RTS has been shown to improve the outcome for other surgical emergencies resulting in a 14% decrease in 24-hour mortality and a greater than 28% reduction in organ failure due to the availability of immediate surgical care and commitment to the intensive care unit (ICU) [29].

Furthermore, a mature RTS is not only efficient but also cost-effective. The amount of life gained or saved is tremendous with evidence of up to 15-fold financial gain on each trauma patient that returns to work [30]. MacKenzie et al [31] reported a $36,319 per life-year gained or $790,931 per life saved as the added cost for treatment at a trauma centre compared to non-trauma centre.

Hence, there’s a huge amount of potential benefits if TS is introduced, implemented, and regionalised in South-West, Nigeria. Although the implementation of TS is associated with an increasing continuum of benefits, these benefits do not occur immediately and may require up to 10 years.

Current challenges

Trauma registry

Information is key to understanding, decision-making, and improvement of trauma care. Currently, Nigeria does not have a centralised and computerised trauma registry(TR) [15]. Data on trauma victims are collected by the FRSC, NBS, and Hospital Health-records. FRSC and NBS report majorly pre-hospital RTC and mortality [12] while Hospital Health-records remotely report all patients who present to the emergency centres in various institutions [18]. These data are manually documented and sometimes, have missing information which impacts negatively on research [15]. Also, there is no data or evidence on post-discharge events. Shreds of evidence from other developing countries suggest similar experiences with TR [32,33].

The aforementioned problems in TR underscore the burden of injury in the region and nation, and lack of desired attention from stakeholders, especially the government [34]. Furthermore, the lack of a centralised TR has resulted in poor research, ineffective trauma care, lack of guidelines, and trauma advocacy [35].

Injury prevention practices

Of note, there is no peculiarity in the injury prevention strategies in the SW region and nationwide. The Federal Government of Nigeria in 1988 established the FRSC aimed at regulating, enforcing, and coordinating all road traffic and safety management activities [36]. Subsequently, several legislations were passed by the National Assembly to curb the injury burden. These legislations include the use of seatbelts by front and rear adult passengers (2003) [37]; prohibition against mobile phone usage while driving (2006) [38]; mandatory use of helmets among motorcyclists (2009) [39]. In addition, the FRSC had standardised the existing driving school system, and recently requested the fitting of electronic speed-limiting devices in all commercial schools [40] among other interventions.

Despite these established legislations, injury statistics have progressively peaked over the years. Also, the most probable causative factors –speed violation, loss of control, and dangerous driving of RTC have remained the same. These could be due to lax implementation, poor infrastructure, or inadequate knowledge, training, and compliance among road users [12]. Moreso, driving under alcohol influence has surprisingly scored low in a country ranked as the leading alcohol consumption per capita in Africa [41]. The low rate compared to other aetiology of RTC might be due to poor availability of testing equipment, insufficient personnel, and data collection.

Prehospital-care system

Prehospital care ensures that patients receive prompt and adequate care from the injury scene to presentation at the hospital [10]. State governments have attempted to close the gap via the establishment of the Emergency Medical Services (EMS). To an extent, a few States of the federation have been successful. Two (Lagos and Ogun) of the five states with functional EMS are in the SW [42]. The established EMS are not without challenges. A performance evaluation of the pioneer EMS, Lagos State Ambulance Service (LASAMBUS) by Venkatraman et al [43] identified some challenges such as public ambiguity in contacting LASAMBUS (multiple telephone numbers containing eleven characters each), a delayed average response time of 17 min (6–60 min), and greater than 50% of unaddressed RTC calls.

Additionally, the logistic problems in Lagos and Ogun ambulance services, the profit-based operation of the privately owned ambulances, and the unavailability of local ambulance services in most states of the region result in the current use of cars and buses as the main modality of transportation in trauma [18]. This can be potentially deleterious to the severely injured as these vehicles are not spacious to admit victims in supine, thus, resulting in secondary injuries and adverse outcomes.

As highlighted earlier, most trauma victims in the region have either relatives, bystanders, or law enforcement agencies as first-responders [17]. Due to a lack of triage and poor decision-making, these first-responders would transfer trauma victims based on the nearness of the hospital rather than resource availability or designation of a hospital [11,18], hence, delaying expert care. Furthermore, the aforementioned first-responders lack knowledge of emergency trauma care. A multicentre study [18] investigating the prehospital-care system in the region found that 91.4% of trauma victims received no form of prehospital treatment. A more interesting finding was that the remaining 8.6% had received substandard care that could be potentially detrimental. This finding highlights the enormous difference trained paramedics could make in trauma survival. Presently, para-medicine is still in the early stages in Nigeria, with only one institute and 236 paramedics graduates [42], Unfortunately, paramedics graduates in Nigeria are employed to work in the emergency centre and involved in the in-hospital patient transfer services or as just ambulance drivers while the hospitals/agencies rely on nurses to render emergency care enroute to the referral [44].

In-hospital care

Improvement of prehospital care may fail expectations if there is no synchronized improvement in the quality of care provided by healthcare institutions within the region. Afuwape et al had predicted that an improved prehospital transfer time would lead to a surge in death in the emergency centre [19]. This could be due to delay in resuscitation following the unavailability of funds as hospital services including emergency are presently out-of-pocket in Nigeria, or increased in-flow of very severely injured trauma patients who would have died prehospital to the under-resourced facilities, etc.

Studies from this region have published a Revised Trauma Score up to 60-80% [11,19]. This score predicts that patients could have better survivability with improved quality of care. This can be achieved through prompt, organised, and adequate resuscitation [45]. Although the tertiary institutions in the region deliver twenty-four(24) h emergency services, these services are majorly provided by about 2-4 medical officers per shift supported by one junior and senior resident doctor upon request [18]. The situation is worse in understaffed lower cadre hospitals that have one medical officer with few years of experience solely manning the emergency centre. Consequently, trauma patients are denied the most experienced care from consultants at the very critical periods which have been proven to impact negatively on the outcome [45].

Additionally, there is a gross deficit in the number of consultants involved in trauma care in Nigeria. Recent reports showed that there are about 97 neurosurgeons [46], 220 anaesthesiologists [47], and 350 orthopaedic surgeons [48] sparsely distributed across the country, and far below the required national minimum by international standards (2000 neurosurgeons, 1000 orthopaedic surgeons, and 1000 consultant anaesthesiologists). The shortage of relevant trauma specialists could be due to increased length of residency training, busy nature of the job, non-differential remuneration, and compounded by the ongoing massive brain drain.

Furthermore, there are no established guidelines for resuscitation and trauma care in the region. Most facilities still utilise crystalloids for resuscitation in trauma which has been reported to be potentially harmful [49]. However, blood bank services in this region are faced with the problem of poor distribution, blood shortage, and commercialisation [50]. Cultural belief is one of the factors affecting voluntary blood donation in the region. Even with the availability of blood, hectic hospital blood request protocols still result in delays in the provision of blood to trauma patients.

Priorities: the way forward

Trauma registries are vital tools used for continuum collection of standardised injury data [51]. The high-income countries have digitalised and centralised data entries which have helped in the research, decision-making, improvement of quality of care, and development of policies [51]. Additionally, TR provides internal quality control, the temporal trend for performance monitoring, and the basis for the proposal of change in legislation [34].

A potential solution to the drawbacks of collecting injury surveillance data is the concept of minimum data set as recommended by the Centres for Disease Control and Prevention (CDC) [52]. This concept ensures that only essential information are captured and was utilised in the development of the Kampala TR form and more recently in Nigeria, the Uyo TR form [53,54]. These existing TRs should be adapted by the hospitals within the region and subsequently pooled into the regional trauma registry. Additionally, data entry and analysis can be performed using the free and user-friendly TR software – Epi-Info, provided by the CDC [55]. Furthermore, the region can leverage the young graduates who are enrolled in the mandatory one-year National Youth Service Corps scheme and deployed to various healthcare institutions as an interim solution to staffing required for the TR.

Injury prevention is a keystone component in the reduction of the global burden of trauma. The implementation of airbags, seatbelts, and crash performance regulations in the US reduced the fatality rates from 5.0 to 1.27 per 100 million motor vehicle miles in ten years [56]. In contrast, there's a poor performance of the established legislation and regulations in Nigeria attributable to inadequate knowledge and compliance among road users, lax enforcement, poor road networks.

The initiation of preventive education and safety awareness campaigns on motor vehicle safety, safe driving, and alcohol dependence prevention endorsed by the state governments, Non-Governmental Organisations, and other stakeholders within the region could improve the trauma burden. Also, strengthening the FRSC and the law-enforcement agencies through increasing the workforce and providing financial support will improve the surveillance system in the region. Furthermore, full implementation of the proposed speed-limiting strategies will discourage over-speeding, the leading causative factor of RTC.

Prehospital care is paramount to the improvement of trauma-associated mortality and morbidity. The Lagos and Ogun state governments with existing EMS should collaborate with network providers within the region to generate a single three-digit toll-free number to solve the telephone number ambiguity among the public, embark on road reconstructions furnished with street lights to improve the average response time, and prohibit the use of siren by non-ambulance vehicles to prevent public desensitisation.

Likewise, the development of EMS in the other four states will contribute to the reduction in risk of potential secondary injuries associated with the current transport modality. The commencement of EMS

in all states as well as the establishment of at least one institute of paramedicine in the region would provide a blueprint for the integration and development of regional EMS or trauma network in the future. Since para-medicine is at budding stage nationwide, the discouraging job description of the current paramedic graduates can be addressed through educating employers on the role of paramedics in triage, resuscitation and transport of trauma victims. .

In the interim, the public, law enforcement agencies, Non-governmental organisations e.g. Trauma Care International, and voluntary organisations e.g. Red Cross Society, Boys Brigade, and Scout could play a crucial role in tackling the prehospital care problem. These cohorts could be equipped with the knowledge and practical life-saving skills in Basic and Advanced Trauma Life Support, wound care, fracture splinting, and haemorrhage control. Evidence has shown the impact of such public health initiatives as seen in the STOP THE BLEED campaign – a public health initiative developed by the American College of Surgeons aimed at equipping the public with basic skills to control bleeding [57]. Adapting such initiative has the prospects of transforming passers-by or onlookers into potential lifesavers.

In-hospital care: There is an absolute need for alignment of the above solutions with improved standards of care within the various facilities. Recent studies have shown the effectiveness of a dedicated and consultant-led trauma teams who have better knowledge and experience in managing trauma [45]. The dedicated team should primarily consist of one Emergency Medicine consultant leading the two to four medical officers and two nursing staffs per shift. An enhanced team consisting of orthopaedics, general surgery, neurosurgery, anaesthesia residents and consultants base on the capability of the hospital should be available on request. Additionally, the chronic shortage of these specialists can be mitigated by encouraging junior-senior doctor mentorship and improving the living, training, and working conditions of both the trainees and consultants. At the moment, trauma training such as the WHO Global Initiative for Emergency and Essential surgical care will provide non-specialist trauma providers with adequate knowledge and skills to carter for mild to moderately injured patients [58].

Guidelines and protocols for the management of trauma patients should be established by dedicated trauma teams from evidence. Since blood and blood-products are the current standard of management in trauma [49], public myth-debunking and awareness campaign could provide a solution to the unavailability of blood [50]. Also, the hectic blood request protocol can be improved by ensuring availability and proper storage of blood within the emergency centre for immediate use while awaiting more supplies from the blood banks, increasing the workforce in the blood banks, further recruitment and training of hospital porters, and inclusion of blood and blood-products in any future health financing or insurance scheme. Furthermore, partnerships with technology-advanced companies such as the zipline – drone delivery company which can deliver blood and blood products would be beneficial [59].

Conclusion

Injury is a major public health problem in the world, especially in developing countries. The South-West region contributes a proportion of the injury burden in Nigeria. Trauma provision within the region is faced with several challenges. Crucial to creating a paradigm shift is the development of a regional trauma system as well as centralisation of the trauma registries, stringent implementation of existing preventive and safety legislations, public engagement with life-saving training and blood-donation campaigns, strengthening the existing ambulance services, commencement of ambulance services in the remaining states, introduction of dedicated consultant-led trauma teams, and establishment of trauma management protocols within the region. Furthermore, the genuine support and sincere commitment of all stakeholders: the government, legislature, law-enforcement agencies, healthcare institutions, non-governmental-organisations, voluntary organisations, trauma experts, and the public is of paramount importance.

Dissemination of results

This article will be disseminated through: Publishing in African Journal of Emergency Medicine; Presentations in upcoming trauma, global health, and/or global surgery conferences; Social media e.g. LinkedIn, Twitter; Governmental and Non-Governmental Organisation websites.

Author contribution

Authors contributed as follow 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: TE contributed 100%. The author approved the version to be published and agreed to be accountable for all aspects of the work.

Declaration of Competing Interest

The author declares no conflict of interest.

References

[1] Hyder AA. Injuries in low- and middle-income countries: a neglected disease in global public health. Injury 2013;44(5):579–80.
[2] Injuries and violence [Internet]. [cited 2022. Available from: https://www.who.int/news-room/fact-sheets/detail/injuries-and-violence
[3] Gwaram UA, Okoye OG, Olaomi OO. Observed benefits of a major trauma centre in a tertiary hospital in Nigeria. Afr J Emerg Med 2021;11(2):311–14.
[4] Reports | National Bureau of Statistics [Internet]. [cited 2021 Oct 13]. Available from: https://nigerianstat.gov.ng/elibrary/read/1164
[5] Howard JM. Historical background to accidental death and disability: the neglected disease of modern society. Prehosp Emerg Care 2000;4(4):285–9.
[6] Bazzoli GJ, MacKenzie EJ. Trauma centers in the United States: identification and examination of key characteristics. J Trauma Acute Care Surg 1995;38(1):103–10.
[7] He JC, Kreiner LA, Sajankila N, Allen DL, Claridge JA. Performance of a regional trauma network: a state-wide analysis. J Trauma Acute Care Surg 2016;81(1):190–5.
[8] Celso B, Tepas J, Langland-Orban B, Pracht E, Papa L, Lottenberg L, et al. A systematic review and meta-analysis comparing outcome of severely injured patients treated in trauma centers following the establishment of trauma systems. J Trauma Acute Care Surg 2006;60(2):371–8.
[9] Gabbe BJ, Biostat GD, Simpson PM, Sutherland AM, Dip G, Wolfe R, et al. Improved functional outcomes for major trauma patients in a regionalized, inclusive trauma system. Ann Surg 2012;255(6):1009–15.
[10] Adeloye D. Prehospital trauma care systems: potential role toward reducing morbidities and mortalities from road traffic injuries in Nigeria. Prehospital Disaster Med 2012;27(6):536–42.
[11] Solagberu BA, Adekanye AO, Ofoegbu CPK, Udoffa US. Epidemiology of trauma deaths. West Afr J Med 2003;22(2):177–81.
[12] Babalola O. Trends and Distributions of Road Traffic Crashes and Injuries, Nigeria, 2013–2016. 2020;
[13] Nigeria. In: Wikipedia [Internet]. 2021 [cited 2021 Oct 13]. Available from: https://en.wikipedia.org/w/index.php?title=Nigeria&oldid=1049609463
[14] The Violent Road: Nigeria's South West [Internet]. AOAV. 2013 [cited 2022 Feb 12]. Available from: https://aoav.org.uk/2013/the-violent-road-nigeria-south-west/
[15] Thanni L, Kehinde OA. Trauma at a Nigerian teaching hospital: pattern and documentation of presentation. AJOL 2006 (Vol. 6 No. 2 (2006)).
[16] NIGERIA-ROAD-TRANSPORT-DATA-2019-09062020.pdf [Internet]. [cited 2021 Oct 13]. Available from: https://kairoscapitalng.com/wp-content/uploads/2020/06/NIGERIA-ROAD-TRANSPORT-DATA-2019-09062020.pdf
[17] Solagberu BA, Ofoegbu CKP, Abdur-Rahman LO, Adekanye AO, Udoffa US, Taiwo J. Pre-hospital care in Nigeria: a country without emergency medical services. Niger J Clin Pract 2009;12(1).
[18] Oluwadiya KS, Olakulehin AO, Olatoke SA, Kolawole IK, Solagberu BA, Olasinde AA, et al. Pre-hospital care of the injured in South Western Nigeria: a hospital based study of four tertiary level hospitals in three states. In: Annual proceedings/association for the advancement of automotive medicine. Association for the Advancement of Automotive Medicine; 2005. p. 93.
[19] Afuwape O, Ogunlade SO, Alonge T. AN AUDIT OF DEATHS IN THE EMERGENCY ROOM IN THE UNIVERSITY COLLEGE HOSPITAL IBADAN. 2009 Jun;12(2):138-140.
[20] Trauma NRC (US) C on, Shock NRC (US) C on.Accidental death and disability: the neglected disease of modern society. US department of health, education and welfare. Health Services and Mental 1970.
[21] Cameron PA, Gabbe BJ, Cooper DJ, Walker T, Judson R, McNeil J. A statewide system of trauma care in Victoria: effect on patient survival. Med J Aust 2008;189(10):546–50.

[22] Utter GH, Maier RV, Rivara FP, Mock CN, Jurkovich GJ, Nathens AB. Inclusive trauma systems: do they improve triage or outcomes of the severely injured? J Trauma Acute Care Surg 2006;60(3):529–37.
[23] Laing GL, Skinner DL, Bruce JL, Aldous C, Oosthuizen GV, Clarke DL. Understanding the burden and outcome of trauma care drives a new trauma systems model. World J Surg 2014;38(7):1699–706.
[24] Findlay G, Martin IC, Carter S, Smith N, Weyman D, Mason M. Trauma: who cares? A report of the national confidential enquiry into patient outcome and death. Lond Natl Confid Enq Patient Outcome Death 2007;2007.
[25] Moran CG, Lecky F, Bouamra O, Lawrence T, Edwards A, Woodford M, et al. Changing the system-major trauma patients and their outcomes in the NHS (England) 2008–17. EClinicalMedicine 2018;2:13–21.
[26] MacKenzie EJ, Rivara FP, Jurkovich GJ, Nathens AB, Frey KP, Egleston BL, et al. The national study on costs and outcomes of trauma. J Trauma Acute Care Surg 2007;63(6):S54–67.
[27] MacKenzie EJ, Rivara FP, Jurkovich GJ, Nathens AB, Frey KP, Egleston BL, et al. A national evaluation of the effect of trauma-center care on mortality. N Engl J Med 2006;354(4):366–78.
[28] Nirula R, Brasel K. Do trauma centers improve functional outcomes: a national trauma databank analysis? J Trauma Acute Care Surg 2006;61(2):268–71.
[29] Lee M, Lee G, Lee J, Yu B. Surgical volumes in a regional trauma center: is it enough? J Acute Care Surg 2020;10(1):10–12.
[30] Durham R, Pracht E, Orban B, Lottenburg L, Tepas J, Flint L. Evaluation of a mature trauma system. Ann Surg 2006;243(6):775.
[31] MacKenzie EJ, Weir S, Rivara FP, Jurkovich GJ, Nathens AB, Wang W, et al. The value of trauma center care. J Trauma Acute Care Surg 2010;69(1):1–10.
[32] Bommakanti K, Feldhaus I, Motwani G, Dicker RA, Juillard C. Trauma registry implementation in low-and middle-income countries: challenges and opportunities. J Surg Res 2018;223:72–86.
[33] Mehmood A, Razzak JA. Trauma registry needs and challenges in developing countries. 2009;
[34] Charters AC, Bailey JA. Experience with a simplified trauma registry: profile of trauma at a university hospital. J Trauma 1979;19(1):13–17.
[35] Ademuyiwa AO, Usang UE, Oluwadiya KS, Ogunlana DI, Glover-Addy H, Bode CO, et al. Pediatric trauma in sub-Saharan Africa: challenges in overcoming the scourge. J Emerg Trauma Shock 2012;5(1):55.
[36] Federal Government of Nigera. Federal Road Safety Commission (Establishment) Act, 2007 [Internet]. [cited 2022 Feb 12]. Available from: https://frsc.gov.ng/about-us/
[37] Popoola SO, Oluwadiya KS, Kortor JN, Denen-Akaa P, Onyemaechi NOC. Compliance with seat belt use in Makurdi, Nigeria: an observational study. Ann Med Health Sci Res 2013;3(3):427–32.
[38] Section D. Traffic offences at a glance [Internet]. Nigeria Highway Code 2022 Feb 12]. [citedAvailable from http://www.highwaycode.com.ng/section-d-traffic-offences-at-a-glance.html .
[39] Oboh M. Nigerian bikers wear fruit shells to avoid helmet law. Retrieved August. 2009;15:2017.
[40] Federal Road Safety Corps Nigeria. FRSC annual report 2017 [Internet]. 2017. Available from: https://frsc.gov.ng/wp-content/uploads/2018/09/AnnualReport2017.pdf
[41] Abiona O, Oluwasanu M, Oladepo O. Analysis of alcohol policy in Nigeria: multi-sectoral action and the integration of the WHO “best-buy” interventions. BMC Public Health 2019;19(1):1–9.
[42] Okhegwai T. Nigeria Emergency Medical Services [Internet]. Paramedicine World. [cited 2021 Oct 13]. Available from: https://www.paramedicineworld.com/nigeria/
[43] Venkatraman C, Odusola AO, Malolan C, Kola-Korolo O, Olaomi O, Idris J, et al. Lagos state ambulance service: a performance evaluation. Eur J Trauma Emerg Surg 2021;47(5):1591–8.
[44] Every state in Nigeria deserves paramedics - Neurological surgeon [Internet]. Punch Newspapers. 2021 [cited 2022 Feb 12]. Available from: https://punchng.com/every-state-in-nigeria-deserves-paramedics-neurological-surgeon/
[45] Keating J, Anderson I, Egan G, Laird C, Ritchie I, Singer B. Trauma care in Scotland. R Coll Surg Edinb. 2012;1–22.
[46] Nigeria needs at least 2,000 neurosurgeons but currently has 97 scattered across 27 states, FCT. [Internet]. Punch Newspapers 2021. [cited 2022 Apr 4]Available from https://punchng.com/nigeria-needs-at-least-2000-neurosurgeons-but-currently-has-97-scattered-across-27-states-fct/ .
[47] Solving manpower deficiency in anaesthesia | The Guardian Nigeria News - Nigeria and World News — Features — The Guardian Nigeria News – Nigeria and World News [Internet]. [cited 2022 Apr 4]. Available from: https://guardian.ng/features/solving-manpower-deficiency-in-anaesthesia/
[48] SICOT e-Newsletter - December 2017: Women in Orthopaedics Part 8 | SICOT [Internet]. [cited 2022 Apr 4]. Available from: https://www.sicot.org/enewsletter-89-women-orthopaedics-8
[49] Sheppard FR, Schaub LJ, Cap CAP, Macko AR, Moore HB, Moore EE, et al. Whole blood mitigates the acute coagulopathy of trauma and avoids the coagulopathy of crystalloid resuscitation. J Trauma Acute Care Surg 2018;85(6):1055–62.
[50] Aneke JC, Okocha CE. Blood transfusion safety; current status and challenges in Nigeria. Asian J Transfus Sci 2017;11(1):1–5.
[51] Schultz CR, Ford HR, Cassidy LD, Shultz BL, Blanc C, King-Schultz LW, et al. Development of a hospital-based trauma registry in Haiti: an approach for improving injury surveillance in developing and resource-poor settings. J Trauma Acute Care Surg 2007;63(5):1143–54.
[52] Nwomeh BC, Lowell W, Kable R, Haley K, Ameh EA. History and development of trauma registry: lessons from developed to developing countries. World J Emerg Surg 2006;1(1):1–8.
[53] Nottidge TE, Nottidge BA, Udomesiet IC, Uduehe EE. Developing a low-resource approach to trauma patient care-findings from a Nigerian Trauma Registry. Niger J Surg 2021;27(1):9–15.
[54] Kobusingye OC, Lett RR. Hospital-based trauma registries in Uganda. J Trauma Acute Care Surg 2000;48(3):498–502.
[55] Zafar H, Rehmani R, Raja AJ, Ali A, Ahmed M. Registry based trauma outcome: perspective of a developing country. Emerg Med J 2002;19(5):391–4.
[56] Centers for Disease. Control and Prevention (CDC)Motor-vehicle safety: a 20th century public health achievement. MMWR Morb Mortal Wkly Rep 1999;48:369–74.
[57] Schroll R, Smith A, Martin MS, Zeoli T, Hoof M, Duchesne J, et al. Stop the bleed training: rescuer skills, knowledge, and attitudes of hemorrhage control techniques. J Surg Res 2020;245:636–42.
[58] Mock C. Guidelines for essential trauma care. World Health Organization; 2004.
[59] Zipline (drone delivery). In: Wikipedia [Internet]. 2021 [cited 2021 Oct 13]. Available from: https://en.wikipedia.org/w/index.php?title=Zipline_(drone_delivery)&oldid=1045878822