



“Trauma—the forgotten pandemic?”

Nigel D. Rossiter^{1,2,3,4,5,6}

Received: 4 September 2021 / Accepted: 6 September 2021 / Published online: 14 September 2021
© The Author(s) under exclusive licence to SICOT aisbl 2021

Abstract

Global annual deaths from Trauma are greater than any other single cause in the global working population, and, more than all contagious diseases added together including COVID-19. The number of people injured, either temporarily or permanently, is greater than any other medical condition. This problem affects Low and Middle Income Countries (LMICs) disproportionately. The numbers are so great as to cause “zone out” and present a human rights issue. This is a particular issue as Trauma presently receives less than 1% of global healthcare funding. This article will highlight and discuss many of the issues and raise some uncomfortable arguments showing that improvement is needed, necessary and achievable.

Keywords Trauma · Global · Advocacy · LMIC · Improvement

Introduction

Deaths from Trauma globally dwarf all other causes of death in the working population. There are approximately six million deaths per year as a result of trauma, which is more than all the contagious diseases added together including HIV/AIDS, TB, malaria and COVID-19 [1, 2] (Fig. 1). There are some 40 million people permanently injured per year, and up to 100 million temporarily injured [3, 4]. In perspective, this equates to the death of all of the population of the island of Ireland, and the entire population of Russia being injured every year. Paradoxically, the issue with these enormous numbers is that when publicised people tend to “zone out”. It is a bizarre fact that a catastrophic incident affecting a few people is more newsworthy and makes more impact

than an incident that affects a city, and, more again than a region or country.

The United Nations (UN) and World Health Organisation (WHO)/World Health Assembly (WHA) have consistently highlighted in the last five years that trauma is the greatest cause of death in ages five to 29 globally [1]. Between 80 and 90% of all trauma occurs in LMICs. Given that the majority of the population in most Low-Income Countries (LICs) is under the age of 35, this affects the working population disproportionately in those countries. It is also estimated that trauma costs global GDP approximately 3% per annum. However as trauma is disproportionately more in LMICs, those countries contribute disproportionately less to global GDP, and affect the working population in those LMICs—it is guesstimated that annual GDP loss in an LIC due to trauma may be as much as 30%. A study performed at Makerere University in Kampala, Uganda, showed that a simple closed tibial fracture in a working man can take up to three times longer for that man to get back to work (up to 18 months) than in an HIC. Within six months, the children of that man were out of school having to earn money to support the family group. The dependants of one working man in an LIC may number as many as 30 and within 12 months of that bread winner’s inability to work those dependents were all struggling [5]. In this way, it can be appreciated how trauma can disproportionately affect the GDP of an LIC. This presumes that that person can return to work and subsequently support their dependants. The WHO estimates that for every \$1 spent on improved and quality healthcare, as poor quality

✉ Nigel D. Rossiter
chair@primarytraumacare.org

¹ Primary Trauma Care Foundation, PO Box 880,
Oxford OX1 9PG, UK

² The G4 Alliance, Chicago, IL 60611, USA

³ Hampshire Hospitals, Basingstoke RG24 7AL, UK

⁴ The Hampshire Clinic, Old Basing, Basingstoke RG24 7AL,
UK

⁵ Orthopaedic Trauma Society, Orthopaedic Trauma education
AO UK & Ireland, Ireland, UK

⁶ Orthopaedic Trauma Association, Rosemont, IL, USA

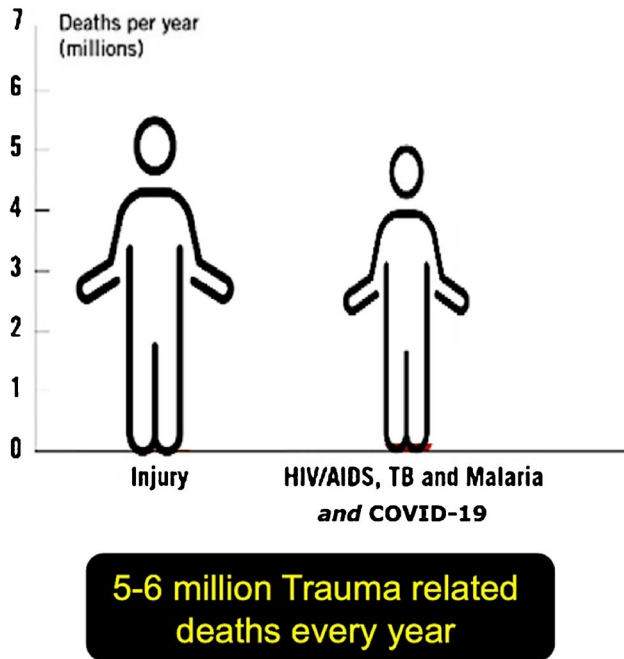


Fig. 1 Trauma-related deaths every year

healthcare costs considerably more money, a minimum of \$10 of increased GDP is achieved in any country [1].

There are obviously multiple reasons for people to suffer a traumatic injury; however, injuries as a result of transport, particularly roads and especially motorcycles, outweigh all others. LMICs disproportionately shoulder that burden. (Figs. 2, 3, 4 & 5).

Trauma causes

In percentage terms, the causes of trauma globally are listed as [6]:

Fig. 2 Traumatic injury: LMIC road traffic



1. Road traffic, 23%
2. (“Others”, 21%)
3. Suicide, 15%
4. “Homicide”, 11%
5. “Falls”, 8%
6. Drowning, 7%
7. Poisoning, 6%
8. Burns, 6%
9. War, 3%

Injury and violence kill considerably more men than women. Death rates from trauma are three times higher in LMICs than in HICs. One percent of the world’s vehicles cause 13% of all deaths and there has been no reduction since 2013 [7] (see the “Road-related trauma” section).

Violence accounts for 29% of all deaths and obviously considerably more injuries. Suicide predominates with lower MICs disproportionately affected, 41.4%; HICs, 24.5%; upper MICs, 23.8% and LICs, 10.2% [8]. The male:female ratio is far greater in HICs.

Homicide rates (2012 figures per 100,000 population) are the greatest in the Americas, 16.3; then Africa, 12.5; Europe, 3.0; Oceania, 3.0 and Asia, 2.9 [9]. If war and homicide were taken out of the equation, there would be a 14% reduction of annual death rate.

Road-related trauma

Globally road-related trauma accounts for the vast majority of trauma deaths and injuries annually and as above disproportionately more in LMICs. This can be broken down into the following: infrastructure, vehicle design and legislation.

Non-metalled, narrow, poorly lit, poorly marked and poorly maintained roads and those without pavements/sidewalks contribute more to road-related trauma in LMICs (Fig. 6).



Fig. 3 Traumatic injury: LMIC transport - motorcycle



Fig. 4 Traumatic injury: LMIC transport - rail



Fig. 5 Traumatic injury: LMIC transport - truck



Fig. 6 Road-related trauma

However, road-related trauma is not just an HIC/LMIC divide—highway design can also contribute. Many high-energy injuries in the North America occur at intersections on leaving freeways, highways and interstates. Most vehicles exiting these major routes come to an intersection and are required to stop and give way. Many “sideswipe” and “T-bone” injuries occur at these intersections as the vehicles do not stop or slow sufficiently, colliding with a vehicle at 90° to them. In Europe, vehicles leaving major routes usually come to a roundabout, “circle” (USA terminology), where they are required to slow down/stop. This probably is a life-saver and the reason that there is a much lower incidence of these injuries in Europe (Fig. 7 & 8).

Pelvic and acetabular trauma in the USA occurs almost eight times more frequently than it does in the UK and quite possibly for this reason [10].

Dramatic improvements in vehicle design in the last 25 years have significantly contributed to the protection of the occupants and of pedestrians [A R Burgess personal communication]. This greater protection comes at a price for the vehicle, one that is often beyond populations in LMICs. Most modern vehicles no longer have a flat front end—it is more often angled towards the wind-screen. This is not just for aerodynamics but also so that any struck pedestrian is thrown up onto, off or over the vehicle and not under it. Unfortunately, the greatest cause of road trauma in LMICs is due to motorcycles. There is little in the design of these that can dramatically protect the rider and it is often not the rider that is the cause of the Trauma. Most motorcycle improvements have been in power to weight ratio, reliance, and, cost reduction—none of which has contributed to the safety of the rider. Awareness of motorcycles by the drivers of other vehicles contributes more to their safety than the motorcycle design. The same is true of bicycles. Motorcycles cost considerably less than other motorised transport and are the transport of choice for many in LMICs and there is often no

Fig. 7 N American intersection



Fig. 8 UK intersection

legislation requiring the passing of tests to use them. It is not uncommon to see an entire family group of up to eight or more people of all ages, with none wearing protective clothing, on one motorcycle in an LMIC (Fig. 3).

It is likely that legislation on the uniform safe use of roads, the provision of and required use of safety equipment in vehicles, the wearing of safety clothing and helmets on motorcycles, restriction on motorcycles to rider and one adult pillion passenger and the enforcement of all of these would contribute most to an individual nation's reduction in road-related trauma.

Trauma systems

Many in HICs take the systematic approach to the severely injured and the system of care for granted. It has taken a century for this to be refined, particularly in the last 30 years [11]. LMICs aspire to this and it is actually probably more

achievable than thought, but enormous gaps presently exist [12]. Trauma systems have been shown to improve outcomes [13–15] and it is estimated that in excess of two million lives may be saved in LMICs if the same standards of care enjoyed by HICs for trauma care were implemented [16]. Whilst much knowledge of the problem exists, little contextual help for each LMIC occurs.

Discussions around trauma can be divided into:

- Prevention (as above)
- Pre-hospital care and transport
- Initial hospital care
- Secondary care
- Rehabilitation
- Data, databases, research, evidence and advocacy
- Changing political will.

Pre-hospital care, transport and initial in-hospital care

First aid training is extraordinarily variable, and perhaps surprisingly, there are no international or accepted standards, or, courses. Many exist. Most are excellent; in some HICs and a few LMICs are even aimed at and taught to school children. HIC ambulance providers training usually goes well beyond first aid—indeed in the UK, many paramedics will perform life-saving techniques, give drugs and blood at the scene which has transformed mortality and morbidity. Many LMICs can presently only aspire to an organised and funded ambulance network plus the attendant staff and their training (see below re cost benefits) (Fig. 9).

Advanced Trauma Life Support (ATLS) was made a reality after an American surgeon and his wife were involved in a small plane crash with their family in 1976. By the early

1990s, this became the standard of assessment, management and communication for all (severely) injured patients in almost all HICs [17]. The concept of systematised care and communication for initial contact with the severely injured is taught to almost all HIC health professionals during their training in some form or another. There is surprisingly little good research evidence proving the good effects and outcomes of this system, suggesting blind acceptance. Whilst generally considered excellent and transformative, the ATLS course however is proscriptive and relatively expensive. As such, it is inappropriate in many LMICS—they cannot afford it and do not have CT scanners, rapid infusers or even blood. In 1996, a group from Oxford, UK, developed a course that addresses this: designed to teach the ATLS concepts and communication but aimed specifically at low resource environments, Primary Trauma Care (<https://www.primarytraumacare.org/get-involved/download-resources/>) (Figs. 10 & 11).

This has been delivered in over 80 countries, training over 80,000 personnel. Whilst the concepts and language of ATLS remain, the training is adapted for whatever low resource environment it is performed in. The training materials are presently free; the course is designed to be delivered

by local instructors where possible and to cascade within a country/region with minimal central input. The use of a recognised system and method of communication aims to reduce mortality and morbidity from trauma at the scene and in the hospital's Emergency Department, or similar, and beyond. Investment into the training of personnel is relatively easy and cheap to achieve and should make enormous differences. A global acceptance and use of the ABCDE system of initial assessment, care and communication for



Fig. 9 LMIC transport of the injured



Fig. 10 PTC (Primary Trauma Care) training, designed to teach life saving techniques, concepts and communication



Fig. 11 Primary Trauma Care in action “in the field”

all injured patients may one day be a reality, but do require evidence into the outcomes.

Investment into coordinated transport/ambulance services is more expensive but in terms of GDP can be recouped by a country and should more than easily pay for itself in the longer term if individual states recognise and invest in this (<http://dcp-3.org/chapter/2586/implications-urgent-care-needs-health-systems>). The WHO have shown that a staffed community rural ambulance would cost \$284 per life year gained, a staffed community urban ambulance \$94, training lay responders and paramedics \$7. By contrast, anti-retroviral drugs for HIV cost \$922 per life year gained (<http://dcp-3.org/chapter/2586/implications-urgent-care-needs-health-systems>).

Secondary care

Once stabilised in an Emergency Department, the patient is either discharged home to be managed as an out-patient or transferred in the hospital to secondary care. If managed as an out-patient, this highlights other issues, in all countries (see below).

Secondary care standards are exceedingly variable in all countries and even between hospitals in a region (Fig. 12).

There are global standards published by the WHO in 2004 (https://www.who.int/violence_injury_prevention/publications/services/en/guidelines_traumacare.pdf). However, these are now 17 years old and many things have moved on. Some standards do exist in various countries—e.g. in the UK, the National Institute of Health and Care Excellence (NICE) has produced guidelines (<https://www.nice.org.uk/guidance/ng39/evidence/full-guideline-2308122833>) and the British Orthopaedic Association (BOA) and have also produced standards of care: BOASTs (British Orthopaedic Association Standards for Trauma) (<https://www.boa.ac.uk/standards-guidance/boasts/trauma-boasts.html>). These coupled with a national programme in England started in 2010 for trauma networks which classified all hospitals, implementing transfer and care standards for injured patients has meant that the probability of surviving a serious injury (Injury Severity Score > 24) is 60% better today than it was in 2009, and costs the country less money. Whilst these improvements took some time to plan and implement, occurred in an HIC and were not without resistance, no one in England would change the system now. The principles can be applied to any nation/system. The system in England is not unique and was modelled on other excellent systems: starting with the Hannover system in Germany, the Maryland system in the USA, the Australian systems and many others. None of these is identical—they are all adapted to the “local” needs, but all have achieved the same as the English system. The BOASTs, NICE, similar guidelines and standards can be relatively



Fig. 12 Resuscitation in an LMIC

easily adapted to any locale and if largely adhered to will improve outcomes and reduce costs. These are not easily achieved in an HIC but are considerably more of a challenge in an LMIC. The same issues that need surmounting in an HIC exist but the relative lack of personnel (there are over 100 times fewer trained medical personnel in an LIC compared to the USA), equipment, training and experience often make these look daunting to any LMIC. The greatest issue is the persuasion of individual states and governments that investment into a system of care will reap infinite dividends and be cost-effective in the medium to long-term when their priorities may seem to be elsewhere.

Rehabilitation

Rehabilitation remains the greatest unresolved medical issue globally in all countries [7]. In almost all countries, HICs included, patients tend to “fall into a hole” once discharged from secondary care to be managed as an “out-patient”. Unfortunately, it is only those with significant funds, and the military, in HICs who can access and benefit from intensive rehabilitation. Military work, particularly in the UK and the USA, has shown that intensive early rehabilitation post injury allows the patient to be able to return to, and contribute to, society quicker, suffer less pain and psychological damage, and is more cost-effective for that society in the long run than the present fragmented care. Rehabilitation does not just include Physiotherapy to physically return that patient to as full a function as possible, but also psychological assistance and occupational therapy to help them either return to their previous profession or train for a new role if needed and/or desired. All of this exists in most HICs but tends to be fragmented, poorly coordinated and performed irregularly so that benefit can be lost between sessions. It

is not just the lack of an early intensive coordinated rehabilitation system but also the significant paucity of these resources, even in HICs (Fig. 13).

These resources may be non-existent in an LMIC (Fig. 14).

It can certainly be argued that a lack of investment into this area is one of the greatest pressures on society as those patients may be alive after their secondary care but are effectively a burden on, rather than contributors to, society and their families [18].

Data, databases, research, evidence and advocacy

In places where system change has occurred effectively, the implementation was almost always driven by the pre-change acquisition and presentation of good data and evidence. For a system to remain effective, it requires regular review of standards of care, updates, audits and databases. These really need to be at national level and ideally international. Every two years, states are required to submit health data to the World Health Assembly. This is commendable but there is presently no agreed dataset to complete so meaningful analysis of the data and comparisons are difficult. In states where agreed datasets are collected on various healthcare topics—for example, in the UK on the Trauma Audit Research Network (<https://www.tarn.ac.uk/Home.aspx>), National Hip Fracture Database (<https://www.nhfd.co.uk/>) and the National Joint Registry (<https://www.njrcentre.org.uk/njrcentre/default.aspx>)—national plans to improve, streamline and reduce costs in healthcare are possible. Many other HICs do the same but few LMICs have instituted these. Data drives advocacy and without good data, evidence for any advocacy to implement change becomes somewhat hollow. The WHO has



Fig. 13 HIC Trauma clinic waiting room



Fig. 14 Result of non-existent rehabilitation in an LMIC

commendably started a global Trauma database: IRTEC (International Registry of Trauma and Emergency Care) (<https://www.who.int/teams/integrated-health-services/clinical-services-and-systems/emergency-and-critical-care>)—watch this space.

Changing political will

Combined effective advocacy backed by data and evidence is required. As previously stated, lots of excellent work have already been done by the UN, WHO, WHA and other international organisations. There is still much that can be done. However, it is the advocacy by individuals, organisations, combined bodies and best of all the people themselves that can change political will to implement change. It is a very sad fact that though trauma is leading cause of death and disability in the global working population, ages five to 30, it receives less than 1% of global healthcare funding [19, 20]. Based on the World Bank Disease Control Priority project, provision of pre-hospital care is extremely cost-effective—as low as \$7 per year life gained for combination systems using lay people and professional paramedics, compared to \$922 for anti-retrovirals for HIV infection (<http://dcp-3.org/chapter/2586/implications-urgent-care-needs-health-systems>). This is yet another

example of disproportionate and inequitable prioritisation of healthcare and has to change.

Good healthcare access is a Human Right. According to the Constitution of the World Health Organization (1956): “The enjoyment of the highest attainable standard of health is one of the fundamental rights of every human being without distinction of race, religion, political belief, economic or social condition.”

In addition, the *AAAQ Framework* (<https://www.ifhbro.org/topics/aaaq-framework/>) states that the right to health imposes four essential standards on healthcare services:

Availability: The need to have sufficient quantity of functioning public health and health-care facilities, goods and services and programmes in sufficient quantity.

Accessibility: Health facilities, goods and services have to be accessible. This means they must be physically and economically accessible (affordable). Accessibility also implies the right to seek, receive and impart health-related information in an accessible format for all, including persons with disabilities, to everyone within the jurisdiction of the state without discrimination.

Acceptability: All health facilities, goods and services must be respectful of medical ethics and culturally appropriate (i.e. acceptable to the individual), sensitive to gender and age. They also need to be designed to respect confidentiality and improve the health status of those concerned.

Quality: Health facilities, goods and services must be scientifically and medically approved, appropriate and of good quality (as we know poor quality healthcare costs more—not just financially).

Conclusion

Reynolds et al. concluded in their assessment of trauma system publications in LMICs that: “there are a number of low-cost, high-value-added organisational interventions that involve only minimal input of new material resources. Quality-improvement, costing, rehabilitation and legislation and governance are particularly neglected areas” [21]. I cannot agree more. Global improvement in trauma care is needed, possible and achievable. It is up to us all to help in this quest.

Author contribution NDR wrote and edited the paper.

Data availability As per references.

Declarations

Ethics approval Not applicable.

Consent to participate Not applicable.

Consent for publication Not applicable.

Competing interests The author declares no competing interests.

References

1. Annual deaths from the WHO Global Health Observatory (2018)
2. WHO (2007) Preventing Injuries and Violence: A Guide for Ministries of Health. WHO, Geneva
3. Wesson HK, Boikhutso N, Bachani AM, Hofman KJ, Hyder AA (2014) The cost of injury and trauma care in low- and middle-income countries: a review of economic evidence. *Health Policy Plan* 29(6):795–808. <https://doi.org/10.1093/heapol/czt064>
4. Debas HT, Donkor P, Gawande A, Jamison DT, Kruk ME, Mock CN, (2015) Essential Surgery: Disease Control Priorities, Vol. 1. Washington, DC: Int. Bank Reconstr. Dev./World Bank. 3rd ed. <https://doi.org/10.1596/978-1-4648-0346-8>
5. O'Hara NN, Mugarura R, Potter J, Stephens T, Rehavi MM, Francois P, Blachut PA, O'Brien PJ, Mezei A, Beyeza T, Slobogean GP (2018) The socioeconomic implications of isolated tibial and femoral fractures from road traffic injuries in Uganda. *J Bone Joint Surg Am*, 4;100(7):e43. <https://doi.org/10.2106/JBJS.17.00439>
6. WHO Global Health Estimates (2018)
7. WHO – Global Alliance for Care of the Injured (2019)
8. Wikipedia – world death rates
9. UNODC study on homicide (2013)
10. Adam Starr, Andy Burgess, and the author: personal communication & research (1997–2001)
11. WHO 72nd World Health Assembly (2019) agenda item 12.9 – Emergency and Trauma care
12. Wong EG, Gupta S, Deckelbaum DL, Razek T, Kushner AL (2014) Prioritizing injury care: a review of trauma capacity in low and middle-income countries. *J Surg Res* 193(1):217–22. <https://doi.org/10.1016/j.jss.2014.08.055>
13. Khan F, Amatya B, Hoffman K (2012) Systematic review of multidisciplinary rehabilitation in patients with multiple trauma. *Br J Surg* 99(Suppl 1):88–96. <https://doi.org/10.1002/bjs.7776>
14. Nathens AB, Jurkovich GJ, Rivara FP, Maier RV (2000) Effectiveness of state trauma systems in reducing injury-related mortality: a national evaluation. *J Trauma*, 48(1) 25–30; discussion 30–1. <https://doi.org/10.1097/00005373-200001000-00005>
15. Roudsari BS, Nathens AB, Arreola-Risa C, Cameron P, Civil I, Grigoriou G, Gruen RL, Koepsell TD, Lecky FE, Lefering RL, Liberman M, Mock CN, Oestern HJ, Petridou E, Schildhauer TA, Waydhas C, Zargar M, Rivara FP (2007) Emergency Medical Service (EMS) systems in developed and developing countries. *Injury* 38(9):1001–1013. <https://doi.org/10.1016/j.injury.2007.04.008>
16. Mock C, Joshipura M, Arreola-Risa C, Quansah R (2012) An estimate of the number of lives that could be saved through improvements in trauma care globally. *World J Surg* 36(5):959–963. <https://doi.org/10.1007/s00268-012-1459-6>
17. ATLS 10th edition (2018) – American College of Surgeons: Library of Congress Control Number: 2017907997 ISBN 78–0–9968262–3–5
18. Mock C, Lormand JD, Goosen J, Joshipura M, Peden M (2004) Guidelines for Essential Trauma Care. Essent. Trauma Care Proj., World Health Organ. (WHO), Int. Soc. Surg., Int. Assoc. Surg. Trauma Surg. Intensive Care (IAT-SIC). Geneva: WHO. http://apps.who.int/iris/bitstream/10665/42565/1/9241546409_eng.pdf
19. Flows of Global Health Financing Seattle, USA: Institute of Health Metrics and Evaluation (2018), [cited 2018 8/12/18]. Available from: <https://vizhub.healthdata.org/fgh/>

20. Trauma care development and development assistance: opportunities to reduce the burden of injury and strengthen health systems (2019). Available from: <https://www.who.int/bulletin/volumes/97/5/18-213074/en/>
21. Reynolds TA, Stewart B, Drewett I, Salerno S, Sawe HR, Toroyan T, Mock C (2017) The impact of trauma care systems in low- and middle-income countries. *Annu Rev Public Health* 20(38):507–532. <https://doi.org/10.1146/annurev-publhealth-032315-021412>

Publisher's Note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.