

At breaking point

Understanding the impact of musculoskeletal injuries in low- and middle-income countries

A report by The Economist Intelligence Unit



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About this report

“At breaking point: Understanding the impact of musculoskeletal injuries in low- and middle-income countries” is an Economist Intelligence Unit report sponsored by the AO Foundation and the AO Alliance Foundation.

The burden of injuries in low- and middle-income countries is substantial, although much of the impact is potentially avoidable. However, whilst we know the burden is high, we don't know how high. We cannot confidently quantify how injuries affect victims, their families and wider society in the developing world because no-one collects this data.

The objective of this report is to improve awareness of the impact of musculoskeletal injuries in low- and middle-income countries and provide examples of good practice in injury response, care and rehabilitation. The report takes a case study approach to investigate musculoskeletal injuries in four countries: Cameroon, Ethiopia, Ghana and India.

For each country we have interviewed trauma care specialists and reviewed the evidence base to understand how many injuries there are, how they impact individuals and wider society, and what work is being done to improve care. We summarise the barriers to change in the trauma care systems in each country and across low- and middle-income countries in general. Our conclusions focus on how trauma care systems can be transformed in order to improve outcomes.

We would like to thank the following interviewees for sharing their thoughts and expertise with us:

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- Dr Samuel Hailu, Trauma Surgeon, Black Lion Hospital, Addis Ababa, Ethiopia
- Dr Wilfred Addo, Trauma & Orthopaedic Surgeon, Saint Joseph Hospital, Accra, Ghana
- Dr Peter Konadu, Trauma & Orthopaedic Surgeon, Saint Joseph Hospital, Accra, Ghana
- Dr Nobhojit Roy, Trauma Surgeon, BARC Hospital, Mumbai, India
- Dr Richard Gosselin, Assistant Clinical Professor, University of California, San Francisco, USA
- Professor Charles Mock, Director of Global Health Minor, University of Washington, USA

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Executive summary

Injuries have traditionally been viewed as consequences of random events or accidents.

Unfortunately, this view of injuries as not being in our control has led to the historical neglect of this area in public health. However, over the last few years, those in the public health arena have realised that policies and guidelines can in fact be put in place to mitigate the severity of the consequences of such accidental events.

In order for policies to be implemented, the magnitude of the problem needs to be highlighted. This report aims to do just this—to improve awareness of the impact of musculoskeletal injuries in low- and middle-income countries (LMICs). Because of the lack of comparative national data, this report takes a case study approach, where we have investigated in detail four countries: Cameroon, Ethiopia, Ghana and India. The goal of this project is to understand the burden of injuries, how they impact individuals and wider society, what work is being done to improve the care of the injured, and to provide suggestions as to where trauma systems can further improve.

Findings of our rapid literature review reveal that:

- Injury disproportionately affects the poor, with 83% of the 4.6 million global deaths from injury occurring in LMICs.
- For every injury related death, 10 to 50 people sustain temporary or permanent disabilities. Injuries result in more than 220 million disability adjusted life years (DALYs) lost each year in LMICs; higher than that for cancer or ischemic heart disease, or for tuberculosis, HIV and malaria combined.
- The main causes of deaths related to injury in LMICs are road traffic injuries, followed by suicide, falls, and other unintentional injuries. Road traffic crashes killed 1.2 million people and injured another 5.3 million in 2016. Low-income countries have more than double the death rate from such crashes than high-income countries.
- Fractures are the most common outcome of injury requiring treatment; an estimated 130 million are sustained worldwide each year.

The highest rate of injury occurs in the working age population, causing a substantial loss of earnings for households and societies. An estimated US\$180 billion is likely to be lost annually due to injury in LMICs.

The case studies highlight that a significant number of people do not have access to timely, safe, affordable trauma care and rehabilitation. Many injured individuals die before reaching hospital; as high as 80% of trauma deaths in Ghana. Community hospitals have inadequate infrastructure, equipment and workforce to perform safe surgery with slow referral systems further delaying care. In addition, patients mostly have to self-fund their treatment, causing some to turn to traditional bone setters, resulting in high levels of complications.

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Death and disability from injury are often avoidable through prevention schemes, simple emergency procedures at the scene, and timely access to good quality trauma care systems with safe surgery and rehabilitation. Trauma systems have proven to be effective in saving lives and improving clinical outcomes. It has been estimated if all-cause injury mortality rates in LMICs were reduced to the level seen in high-income countries, more than two million lives, 50 million DALYs, and US\$786 billion could be saved annually.

We conclude that there is a great deal that can be done to improve this neglected burden. Key suggestions and priorities include:

1. Improve the understanding of burden of injuries through surveillance and trauma registries

Collecting data on traumatic injuries physically shows that this problem exists and cannot be ignored. Quantifying the burden is not only important to health policy makers, but in order to assess progress, data collection is absolutely necessary. Furthermore, in LMICs, hospitals and health centres often collect data in silos. Integration of registries at a national level can allow for comparisons and can identify disparities, which is vital to national policy making.

2. Reclaim the golden hour; small improvements to pre-hospital care can have large outcomes

The first 60 minutes after an injury, known as the golden hour, can define the outcome of injury victims. The golden hour is when prompt medical or surgical treatment has the highest likelihood of preventing death and severe disability. High income countries usually have established and efficient emergency services. This is not the case in some LMICs, and so small, simple improvements to pre-hospital care at the scene of the trauma can help to improve outcomes in trauma victims.

3. Simple rehabilitation measures will speed recovery, reduce morbidity, and ultimately save money

After acute treatment, on-going rehabilitation therapy can further reduce morbidity and complications. Issues regarding rehabilitation include access (geographical as well as financial) and poor resources. A simple way to improve rehabilitation can be to train patients and their family members in rehabilitation techniques and self-care. This can improve morbidity outcomes and quality of life. In addition, investment in rehabilitation centres is required, and distribution of the necessary equipment to help patients with their recovery process is needed, as well as making care more affordable.

4. A horizontal systems-based approach to improving trauma care is required

Often, trauma and injury can be isolated from the rest of the health system. Treatment usually involves surgery, followed by discharge. However, severe trauma can affect many parts of the body, as well as impact the rest of someone's life. Therefore, a horizontal, integrated approach is required to treat trauma more holistically. Trauma patients not only require trauma surgeons, but a range of surgeons, anaesthetists and other healthcare professionals that all depend on the same health system resources. There needs to be creation of health standards and guidelines, and more collaboration and coordination between services.

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5. Without political will, nothing will change; engage politicians and policy makers to ensure injuries are made a national priority

Trauma care requires political will. Many LMICs lack governmental direction on trauma care and do not have operational national trauma policies in place. National trauma plans need to be actively implemented by policy makers. In addition, investment is required in health systems to integrate care, to provide resources, and to change and innovate existing care for the better.

6. Advocate for change; investment in trauma care means investment in the wider healthcare system

The problems that exist in trauma care, such as scant resources and poor workforce are not new. They have existed for years. Those that work in this area do not appear to be heard. Change requires highlighting that a problem actually exists and that fixing this problem is an investment and not a cost. International injury advocates need to make the case that improving trauma care will also improve the provision of healthcare for the population. This can significantly help to channel investment into an area that desperately needs it.

The burden of injuries

A silent epidemic; cruel and unnecessary

Accidents can happen in a moment, yet their consequences can last a lifetime. Prompt treatment after an accident offers the greatest chances of preventing death or permanent disability. But in low- and middle-income countries (LMICs), the survivor would be lucky to get a taxi, let alone an ambulance. At arrival to a healthcare facility, they are often forced to wait again as personnel and equipment may not be available. Unnecessary lives are lost, working lives are cut short, and families are impoverished.

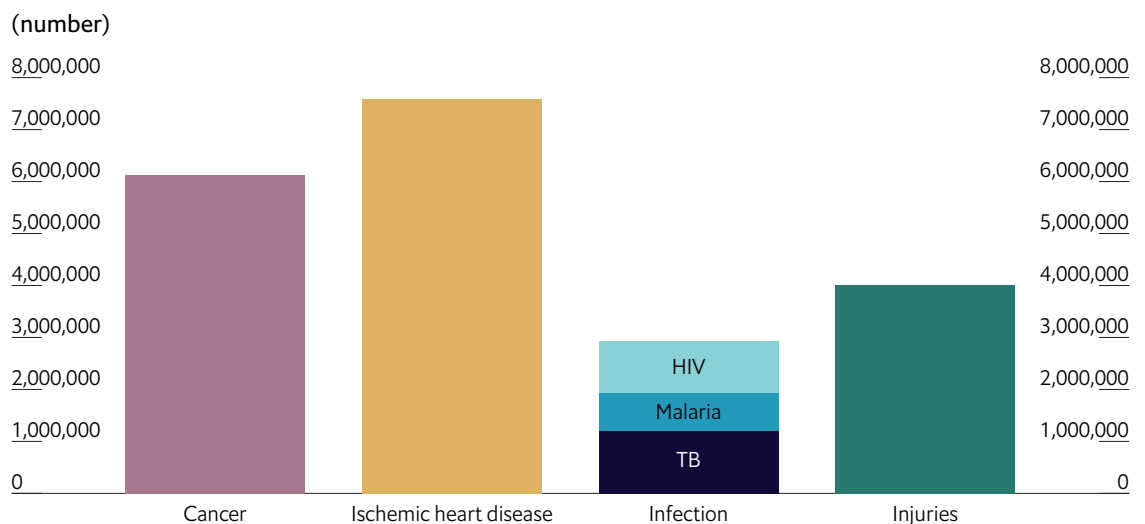
Some injuries are fatal, but many are not. Most non-fatal injuries are musculoskeletal, impacting on the muscles, bones and soft tissues. As this is the most common type of injury that individuals experience, it is important to understand the burden it places on people and populations. The objective of this report is to improve awareness of the impact of musculoskeletal injuries in LMICs and provide examples of good practice in injury response, care and rehabilitation. Because of the lack of available data across LMICs, this report takes a case study approach to investigate musculoskeletal injuries in four countries: Cameroon, Ethiopia, Ghana and India.

Over 80% of total deaths from injury occur in low- and middle-income countries

In 2016, 4.6 million people died from injury and 620 million people sustained injuries that required treatment. Injury disproportionately affects LMICs, with 83% of the 4.6 million global deaths occurring in developing countries.¹ Deaths from injury in LMICs are 59% higher than those from tuberculosis, malaria and HIV combined yet they continue to receive comparatively little attention (Figure 1).

Young men are most at risk; around half of worldwide deaths from injury were in men aged 15 to 29.¹

Figure 1: Total number of deaths caused by injuries, infection (HIV, malaria & TB), ischemic heart disease and cancer in LMICs in 2016



Source: Global Burden of Disease, IHME 2016.

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These young men are often the main, sometimes sole breadwinner in a family. Unsafe travel, living, and working conditions coupled with limited preventative strategies contribute to the disproportionately high burden of injuries in developing countries. Risk of death and disability is further heightened by poor access to timely and safe emergency care, treatment and rehabilitation services in many countries.

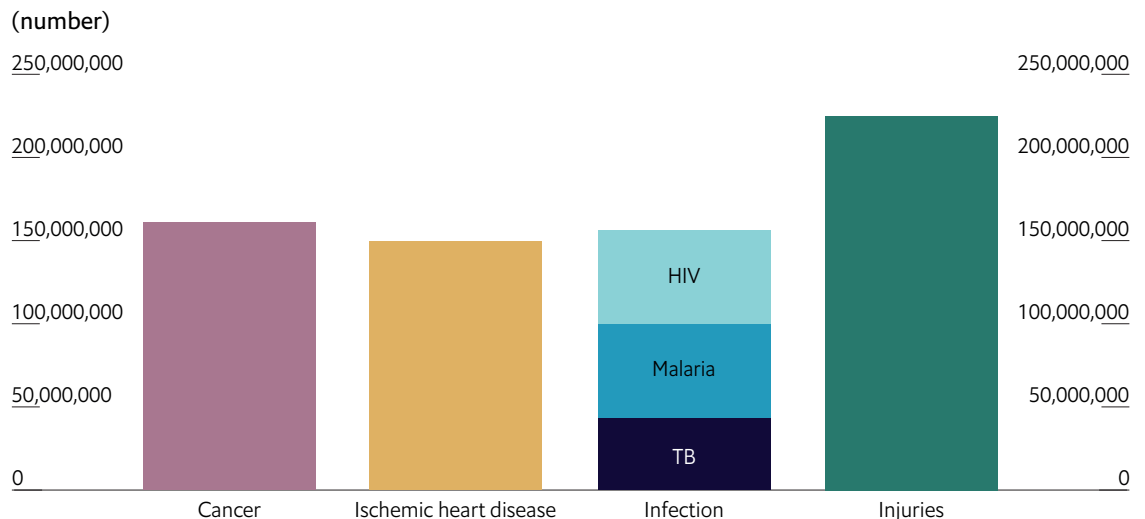
Most non-fatal injuries are musculoskeletal injuries

For every injury related death, many more patients sustain temporary or permanent disabilities. Musculoskeletal injuries account for the majority of this burden.² Bone fractures are the injury type that most commonly require treatment; an estimated 130 million are sustained worldwide each year.³ Approximately 1.0 to 2.9 million femoral shaft fractures (broken thigh bones) are caused by road traffic crashes, of which 91% occur in developing countries.⁴

With global data on injury related disabilities lacking, estimates vary widely, ranging from 10 to 50 disabilities sustained for every death in LMICs, totalling an estimated 12-200 million disabilities a year.

The Global Burden of Disease study estimates that injuries result in more than 220 million disability adjusted life years (DALYs) lost each year in LMICs; higher than that for cancer or ischemic heart disease (IHD), or tuberculosis, HIV and malaria combined (Figure 2).¹

Figure 2: Disability-adjusted life years (DALYs) due to injuries, infection (HIV, malaria & TB), ischemic heart disease and cancer in LMICs in 2016



Source: Global Burden of Disease, IHME 2016.

Many people do not have access to timely, safe, affordable trauma care

Up to 80% of injured people die before reaching hospital in some LMICs.⁵ Often deaths could be prevented with simple, on the scene emergency procedures and shorter transport times to hospital. However, most LMICs lack an organised pre-hospital system and if ambulances are available they tend to be purely for transport rather than emergency treatment.⁶ Pre-hospital care is a particular challenge

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in rural areas, where the nearest facility with the necessary equipment, infrastructure and expertise may be many miles away.⁷

Surgery is an essential part of trauma care. However at least 4.8 billion people worldwide are estimated not to have timely access to safe, affordable surgery, and more than 2 billion people do not have any access to surgery and anaesthesia (94% of individuals in LMICs compared to 15% in high-income countries).⁸ Developing countries have fewer operating rooms, surgeons per capita and surgical equipment.⁹

Rehabilitation is another core component of the trauma care pathway that is not accessible for many people in LMICs. Very few injured patients have access to rehabilitation services, which are critical to minimising disability through improving functioning and independence, and reducing secondary complications.

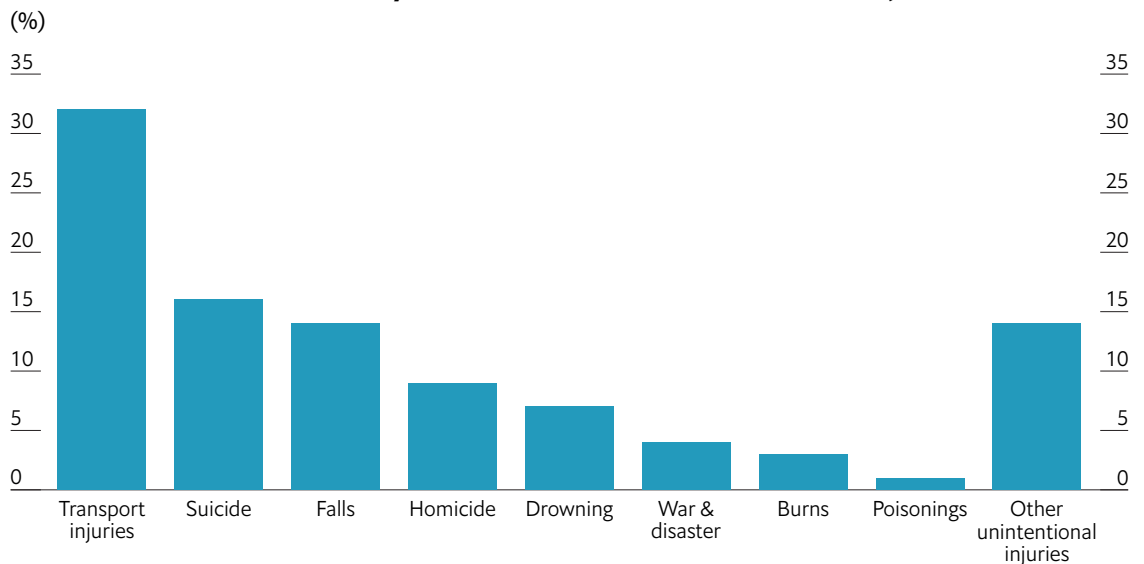
The tragedy is that injury-related death and disability are largely preventable through injury prevention schemes and accessible, good quality, trauma care systems. If injury related death rates in LMICs could be brought down to the levels seen in high-income countries, 2.1 million lives would be saved, and 49-52 million DALYs could be averted each year.¹⁰

Causes and consequences

A third of all injuries happen on the road

Injuries can be classified as either intentional or unintentional. Intentional injuries include causes such as suicide, homicide, violence and war. Unintentional injuries include those which are transport related or due to accidental poisoning, falling, fires and drowning. The main cause of death as a result of injury in LMICs are transport injuries (mostly road traffic crashes), followed by suicide, falls, and other unintentional injuries (Figure 3).¹ While there is growing recognition of the burden of accidents on the road, Professor Charles Mock, from the University of Washington, noted that “injury from a lack of road safety still receives far less attention than would be appropriate given how much death and disability it causes”.

Figure 3: The main cause of deaths related to injury in LMICs are transport injuries (mostly road traffic crashes), followed by suicide, falls, and other unintentional injuries



Source: Economist Intelligence Unit.

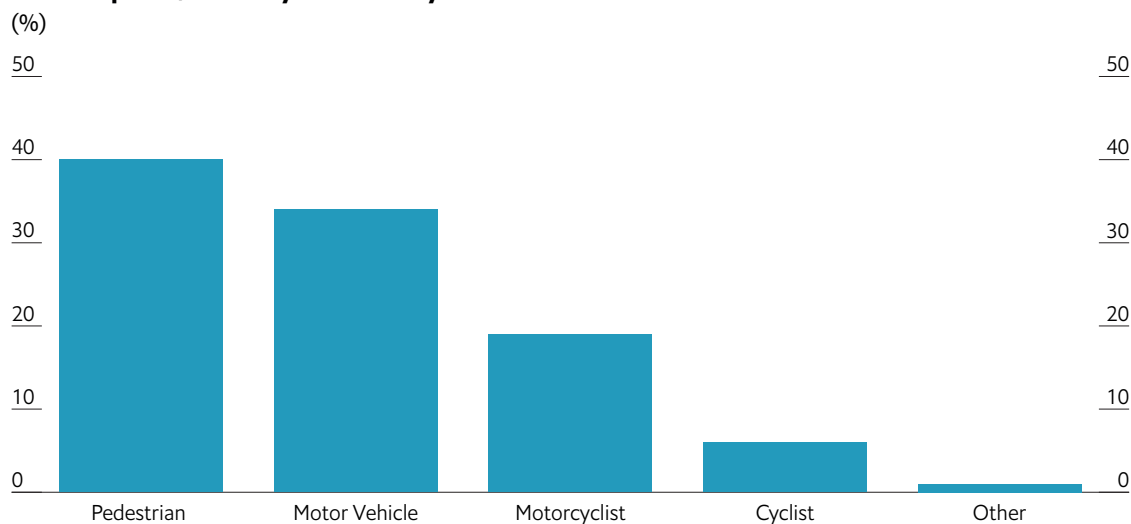
Road traffic crashes are amongst the top ten causes of death in LMICs, killing 1.2 million people and injuring 5.3 million in 2016. They are also the biggest cause of death in young men. Despite higher rates of vehicle ownership in high-income countries, nine out of ten global road traffic deaths occur in LMICs.^{1,11} This high burden has a number of causes, including poorly maintained roads, little or no segregation of vehicles and pedestrians, limited legislation and a lack of law enforcement. Pedestrians are most likely to be killed in road traffic crashes in LMICs, followed by car occupants, motorcyclists and cyclists (Figure 4).¹

Low-income countries already have more than double the death rate from road traffic crashes than high-income countries. Nevertheless, global injury expert Dr Richard Gosselin believes these rates will rise further unless efforts to improve road safety are increased. He argues that as economic development increases, “vehicle use will rise, but if infrastructure, such as roads, isn’t improved then

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Figure 4: Pedestrians are most likely to be killed in road traffic crashes in LMICs, followed by car occupants, motorcyclists and cyclists



Source: Economist Intelligence Unit.

you will get more injuries”. He went on to say that while “there are some efforts for better prevention in middle-income countries that have been motorised for longer—they have some laws and the infrastructure is getting better—the efforts aren’t like those in high income countries.”

Global institutions are however increasingly recognising the problem. In 2010, a decade for action on road safety was launched by the United Nations General Assembly. And as part of the Sustainable Development Goals (SDGs) in 2015, countries made an ambitious commitment to halving the number of global deaths and injuries due to road traffic crashes by 2020. However, on the basis of current trends, no country is likely to meet the SDG target.¹²

Non-transport injuries have not received enough attention from governments or researchers

Unintentional non-transport injuries, such as falls and burns, receive little attention from government agencies and researchers compared to road injuries, even though they are comparable in terms of burden of death and disability. After road traffic crashes, falls are the most frequent cause of injury related death in LMICs. They resulted in 543,000 deaths in 2016 and 28 million DALYs.¹ Although injuries from falls do happen to children, the majority occur in the elderly, so as life expectancy in LMICs rises, the burden of injury will also increase.

Occupational falls are also a growing problem, and 90% of work injury related deaths occur in LMICs. This figure is likely an underestimation due to poor reporting of workplace accidents and the many people working in the informal sector. As reporting improves, workplace figures continue to rise, although this is also due to the transfer of more dangerous jobs to LMICs. In 2016, an estimated 315,000 deaths in LMICs were attributable to occupational injuries, two thirds of which were transport related.¹³ Alongside falls, burns also contribute to the burden of injuries, causing an estimated 115,000 deaths.¹ Hazardous work environments and unsafe cooking appliances are the major causes of burns in developing countries.

Injuries place an immense financial burden on victims and their families

The socioeconomic impact of injuries on families, communities and society in LMICs is substantial. Families can be driven into poverty through the loss of the sole earner, caring for a family member disabled by injury and high medical care expenses. An estimated 33 million people undergo financial hardship every year from the direct costs of essential surgical care. An additional 48 million incur hardship from the non-medical costs of transportation, food and lodging necessary to obtain surgery.

The risk of catastrophic expenditure and impoverishing expenditure is highest in low-income countries and those countries with a lower portion of GDP devoted to healthcare and more reliance on outside funding.¹⁴ Indeed, many health systems in LMICs rely on out-of-pocket costs to fund healthcare; in 2015, such payments equated to 36.6% of total health expenditure.¹⁵ Out-of-pocket payment systems can perpetuate poverty and lead many individuals to delay or forgo necessary care, increasing the risk of death and lasting disability.¹⁶

The annual impact of injuries to LMICs is as high as \$180 billion

Because most injuries occur in the working age population their impact on loss of earnings is substantial. From 2015 to 2030 an estimated US\$7.86 trillion is expected to be lost globally due to injuries; LMICs are projected to experience losses that are almost 50% greater than high-income countries. For example, central and southern sub-Saharan Africa is estimated to lose up to 2.5% of GDP to injuries in 2030, more than double the losses expected in western Europe.¹⁷

The Economist Intelligence Unit has estimated that the impact of injuries in LMICs in 2016 alone amounted to US\$180.2 billion. Given that the cost of economic losses from road traffic injuries in LMICs are thought to be around the US\$100 billion mark per year, this estimate seems reasonable (for full methods see the appendix). This suggests that the economic burden of injury is higher than that for cancer, with World Health Organization (WHO) estimates of US\$100.7 billion loss per year in LMICs, respiratory disease, at US\$106 billion annual loss, and diabetes, at US\$28 billion.¹⁸

Despite this burden, injuries remain mostly ignored

Despite their substantial burden and impact, injuries continue to receive relatively little funding compared to competing health priorities such as malaria, HIV and tuberculosis. Professor Mock noted that death and disability from injury “remains neglected as a global health priority because it has not caught the attention of governments and populations as something that is important and something for which there are straight forward solutions.” The figures bear out this view. Between 1990 and 2014, US\$458 billion of development funding for health was donated to low- and middle-income countries. In this time period, 28% of all donations were allocated for maternal, newborn and child health and 23% for HIV, whilst just 1.5% was prioritised for non-communicable diseases, of which injuries make up a very small component.¹⁹

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Given that, worldwide, injuries kill more people than HIV, malaria and tuberculosis combined and the lack in availability of cost-effective interventions to prevent and treat injuries, there is clearly a need to address this imbalance of funding. Dr Gosselin notes that death and disability from injury remains neglected as a global health priority as they aren't as clear cut as well-defined diseases such as types of non-communicable diseases or HIV and malaria—"everyone gets injured throughout life, but it seems like it's a natural phenomenon as opposed to getting HIV." He laments that while it is possible to "find a star somewhere to become a champion for diabetes or an Angelina Jolie for famine, malaria or TB, you won't find someone for injury".

Musculoskeletal injuries in four case study countries

There is very limited data on the burden and impact of musculoskeletal injuries in LMICs. Most have poor or non-existent centralised death registration systems and instead use data from the police, which is frequently incomplete. Very few LMICs have ongoing comprehensive trauma registries. Research consists of mostly small, retrospective case series of trauma patients admitted to a single hospital, which makes it difficult to assess the total burden of musculoskeletal injuries (treated or untreated) across rural and urban areas. Similarly, it is impossible to systematically assess the magnitude and consequences of associated disability.

Dr Florent Anicet Lekina, a general and trauma surgeon in Yaoundé, summarised the situation as “no mortality data, little police data, no centralised data for recording road traffic accidents. We have no information on disabilities. We do not know what happens to patients when they leave the hospital.”

The Global Burden of Disease (GBD) Study offers the most robust country-specific estimates of incidence, death and DALYs associated with injuries. However, the GBD’s estimates are not for musculoskeletal injuries specifically. They do however report on cause-specific injuries, with transport, falls, physical violence, exposure to mechanical forces and non-venomous animal contact being the most likely to result in musculoskeletal trauma (termed “injuries likely to result in musculoskeletal trauma” for this report). In the absence of reliable data on musculoskeletal injuries, these estimates have been used, but we do not know how many of these injuries will actually result in musculoskeletal injuries.¹

In the following four country case studies, we describe the situation in Cameroon, Ethiopia, Ghana, and India using a combination of data from the GBD Study and other studies from the literature, with information and insight from interviews of local trauma specialists. We look at estimates of the number of musculoskeletal injuries and their burden in terms of death and disability. We go on to describe the financial and wider societal impacts, and finally outline some of the main challenges facing each country in their trauma care systems. In addition, for each country we have adapted the method from Dewan and colleagues²⁰ to calculate an estimate of the incidence of musculoskeletal injury in 2016 (see methods in appendices).

Cameroon

Country Snapshot

- World Bank Classification: **Lower Middle Income**
- Population: **25 million**
 - Population aged 15 and under: **43%**
 - Population aged 65 and over: **3%**
- Life Expectancy (years)
 - Men: **57**
 - Women: **59**
- Population living in Urban Areas: **55%**
- Income per capita (PPP): **US\$3,250 (2016)**
- Current Health Expenditure (% GDP): **5.1%**
- Economist Intelligence Unit Infrastructure Rating: **4.4 (10=good)**
- Passenger cars: **11 per 1,000 (registered cars in use)**

The Big Numbers

- **4,499 per 100,000** sustain injuries likely to result in musculoskeletal trauma
- The Economist Intelligence Unit has estimated that **1 in 15** of these injuries will result in musculoskeletal trauma
- **31.6 per 100,000** die from injuries likely to result in musculoskeletal trauma
- **2,174 per 100,000** DALYs are lost from injuries likely to result in musculoskeletal trauma

Number of injuries and deaths from causes likely to result in musculoskeletal trauma in Cameroon in 2016



Falls

Incidence: 536,805
Deaths: 1,743



Mechanical forces

Incidence: 231,159
Deaths: 933



Transport injuries

Incidence: 142,700
Deaths: 3,962



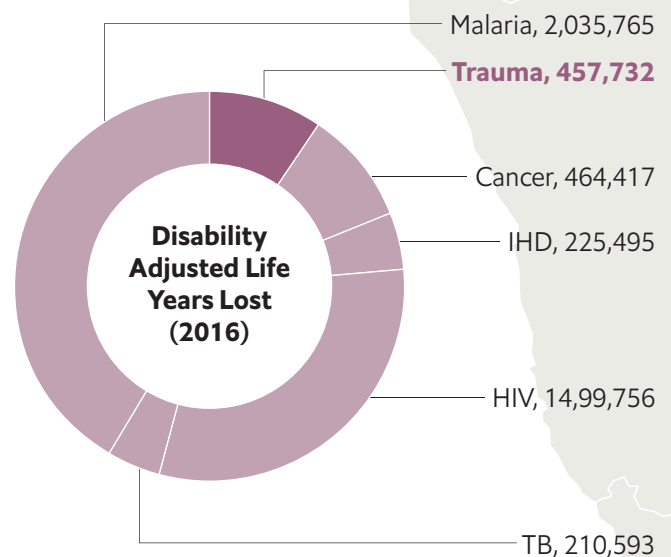
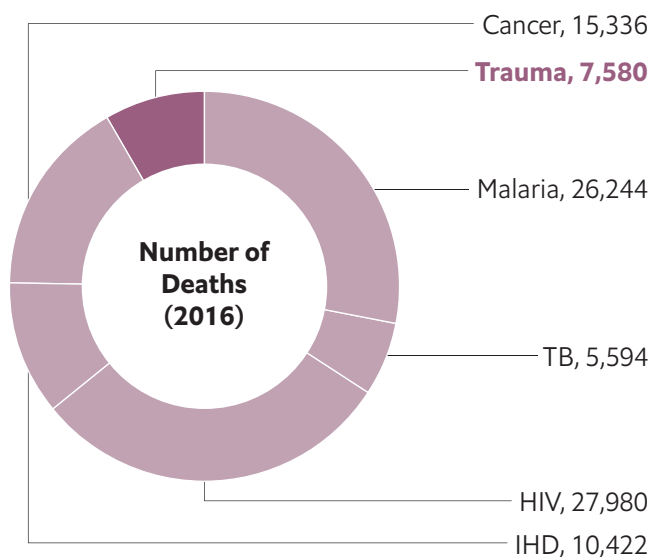
Animal contact

Incidence: 123,344
Deaths: 75



Interpersonal violence

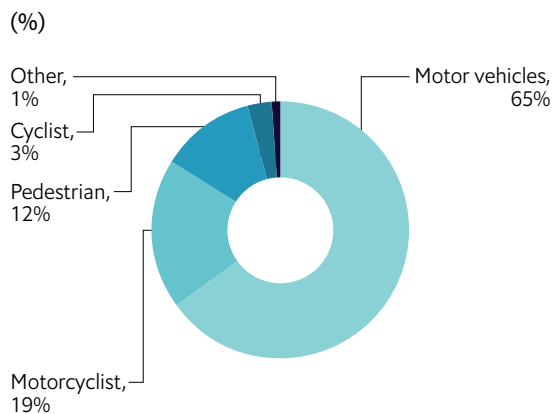
Incidence: 45,773
Deaths: 867



Case study 1: Cameroon

Road traffic crashes cause most injury-related deaths in Cameroon, and are the third biggest cause of all deaths, after HIV and TB, in men aged 15 to 49.¹ Many roads remain unpaved, traffic legislation is poorly enforced, including helmet use, drink driving and driving licenses, and there is no legal requirement for vehicle roadworthiness. In the absence of regular public transport, taxi motorcycles are often used (known as “Bend Skin” in Douala), whose riders mostly lack training and are not regulated.²¹

Figure 5: Mode of transport involved in fatal road traffic crashes in Cameroon in 2016



Source: GBD 2016.

Motor vehicles are the most common mode of transport involved in fatal road traffic crashes in Cameroon (15 deaths per 100,000 in 2016), followed by motorcycles (4.3 per 100,000), pedestrians (3 per 100,000) and bicycles (0.6 per 100,000) (Figure 5). This is a different pattern to that seen in other lower-middle income countries: accidents involving motor vehicles are double the average rate for lower-middle income countries and accidents involving pedestrians are half the average rate.¹

The number of deaths from road traffic crashes continue to increase (from 2,036 in 1990 to 3,725 in 2016), placing a growing burden on the health system. Dr Olama Atangana noted that “road traffic accidents are increasing as the population grows and roads aren’t improving.” However, while absolute numbers continue to increase, the rate of death from road traffic crashes is declining, albeit at a slow rate. They’ve fallen from 17.2 deaths per 100,000 in 1990 to 15.5 per 100,000 in 2016.¹

A recent study looked at road traffic accident victims admitted to the casualty department of the largest hospital in the city of Douala in Cameroon. Over a five month period, the investigators found that just under three quarters of the 811 victims were men aged between 21 and 50 years. The investigators also found that:²²

- The most common mode of transport was motorcycles (58%) followed by pedestrians (22%).
- Over 95% of victims admitted to not using any form of protective device (helmet or safety belt).
- Around a third of victims (35%) sustained a long bone fracture.
- The most frequently affected bones were the tibia (23%), the fibula (19%) and the femur (11%).
- 1% presented with a traumatic limb amputation.

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- 3% required a minor surgical procedure (suturing of lacerations or cast immobilization of fractures), 19% underwent a surgical procedure (mainly bone stabilising surgery) after a short period of admission, 5% underwent emergency major operation.
- 6% of victims died within one week of admission.

Much of the literature on musculoskeletal injuries in Cameroon is centred around road traffic accident victims. Few studies assess the burden and impact of other causes, such as falls and violence. Four case studies were found of trauma patients admitted to hospital; these showed that the most common cause of trauma resulting in admission were road traffic accidents followed by falls.²³⁻²⁶

Financial and societal impact

There has been little effort to quantify the social and economic costs to society associated with injury-related death and disability in Cameroon. A pilot six-month trauma registry in the Central Hospital of Yaoundé in 2009 found that the average cost of emergency care treatment for 2,855 injured patients was approximately 8,613 Central African CFA. This is equivalent to US\$18.25 at time of registry, and roughly equivalent to just under one week's salary for the average Cameroonian. These costs do not include further hospital treatment likely to be received by the more seriously injured patients, such as ward care, intensive care, or surgery. For example, a quarter of injured individuals required minor operative treatment, while 18% needed major surgery. Nearly all of the patients paid out-of-pocket.²³

These high costs have consequences; Dr Atangana said that “many patients are too poor to afford treatment and go to traditional healers.” Dr Lekina Florent Anicet of the General Hospital in Yaoundé confirmed that “injuries cause major social and economic impact. Poor people who walk and use motorbikes have the most accidents and they have no money to be treated”. He went on to say that most are young men and the only person who work in the family, and that because they can no longer work, the family becomes poorer. Adding that “most cases become handicapped for life as they did not get the right treatment. It’s a very serious problem”.

Risk of catastrophic & impoverishing expenditure from surgery

Just under two thirds (64%) of the population of Cameroon are estimated to be at risk of catastrophic expenditure (spend on medical care that reduces income by 10%) from surgery

(including for injury) and just over half (52%) of the population are at risk of impoverishing expenditure (reducing them to below the national poverty line).

Looking at the poorest part of the population only, 92% are estimated to be at risk of catastrophic expenditure from surgery and 100% of population are at risk of impoverishing expenditure.¹⁴

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Lost output from injury related deaths

The value of lost output from deaths due to injuries is estimated to result in a cumulative loss of US\$8.67 billion in Cameroon between 2015 and 2030. This number captures loss of productivity

and would translate to an economic loss of up to 0.76% of all economic output by 2030.

If welfare losses are incorporated, injuries are estimated to result in \$3.11 billion or 6.24% of GDP in 2010 alone in Cameroon. This measure, broader than GDP losses, captures the inherent value that individuals place on their own good health.¹⁷

Current situation and challenges for trauma care

Healthcare financing

There is no social health security system in Cameroon and health insurance is almost non-existent. Cameroonians themselves pay for most health services, including emergency services and trauma care, through out-of-pocket payments. Total health expenditure in Cameroon for 2015 was 5.11% of GDP.²⁷ Out of the US\$156 spent on health per person in Cameroon in 2015, 69% was out-of-pocket spending, 15% government health spending, 13% development assistance for health spending and 3% prepaid private spending.²⁸

Dr Lekina explained that there are real problems with delays in trauma care while they wait for the family to source money to fund treatment. His hospital has a limited number of free emergency packages and there is some international funding for paediatric trauma care and open fracture care in Yaoundé, but otherwise patients must pay for treatment themselves.

Governance and policy

Cameroon currently has no operational national trauma care policy. Hospitals have to work under their own direction, with little central guidance. Dr Lekina remarked that there is “currently no strategy from any authority. It is left up to the surgeons and there are no systems behind what we do.”

Information systems and registries

Cameroon has no national trauma registry. A few trauma registries have been run in the past, but these have been short-term and based in single hospitals.^{23, 25} Plans are underway to set up a national web-based trauma registry, which should be operational by the end of 2018. The website is running, but the registry needs government approval before it can start, and hospitals need to find funds to develop a system and train staff to record trauma patients.

Healthcare workforce

There are an estimated 25 to 50 specialised trauma surgeons (only one to two trauma surgeons per million population) working in Cameroon, with many general surgeons having to treat musculoskeletal injuries, particularly in rural areas. Interviewees suggested that the number of trauma surgeons is limited in Cameroon because no-one wants to work in trauma care.

AT BREAKING POINT

UNDERSTANDING THE IMPACT OF MUSCULOSKELETAL INJURIES IN LOW- AND MIDDLE-INCOME COUNTRIES

Service delivery

Pre-hospital trauma care

The pre-hospital trauma care system in Cameroon is limited in scope. There are no formally trained first-responders and very few ambulances, and those that do exist are only found in large cities. A study looking at pre-hospital care patterns in Yaoundé found that only 3% of the 2,855 injured patients were transported by ambulance, leaving the majority to the mercy of bystanders, family and friends using taxis, buses and private cars.²⁹ Over half of road traffic victims in Douala take more than 90 minutes to arrive at a hospital²⁵; those living in rural areas are likely to take much longer.

Hospital-based trauma care

District hospitals provide initial care for most injuries in Cameroon, yet they have limited trauma care services. A survey of 25 district hospitals in the Centre Region of Cameroon in 2012 found that the majority were not compliant with the WHO/IATSIIC guidelines for essential trauma.³⁰ Each hospital had at least one dedicated medical doctor, but few nurses, and skills for managing specific injuries were poor with little trauma management training: 84% of healthcare workers claimed to be unskilled in chest injuries and 24% unskilled in head injuries. Coupled with this, hospitals had inadequate availability and utilisation of suitable equipment. In many cases this was said to be due to organisational issues, such as absence of staff needed to operate equipment, rather than shortages of the equipment itself. Very few hospitals had trauma care guidelines or checklists, a dedicated trauma team or training plan.³⁰

Dr Atangana reported that hospitals don't have enough money to support equipment, leaving surgeons to take on the maintenance costs themselves or face having essential equipment like CT scanners out of action for long periods of time. He noted that "we try our best, but with a lack of equipment and trained staff there is only so much we can do."

Rehabilitation

There are only three institutions that offer rehabilitation in Cameroon. These are in Yaoundé, Douala and Bafout, and are inaccessible for most of the population in terms of cost and location. In summary, Dr Atangana bluntly told us "nothing is good; everything needs to be improved—transportation, treatment, rehabilitation—everything."

Ethiopia

Country Snapshot

- World Bank Classification: **low-income country**
- Population: **105 million**
 - Population aged 15 and under: **42%**
 - Population aged 65 and over: **3%**
- Life expectancy at birth (men/women) = **63/67 years**
- Population living in Urban Areas: **20%**
- Per capita income (PPP): **US\$1,730 (2016)**
- Current health expenditure as a % of GDP = **4.1% (2015)**
- Economist Intelligence Unit Infrastructure Rating (10=good) = **3.5**
- Passenger cars: **0.95 registered cars in use per 1,000**

The Big Numbers

- **3,413 per 100,000** sustain injuries likely to result in musculoskeletal trauma
- The Economist Intelligence Unit has estimated that **1 in 14** of these injuries will result in musculoskeletal trauma
- **34.2 per 100,000** die from injuries likely to result in musculoskeletal trauma
- **2,360 per 100,000** DALYs are lost from injuries likely to result in musculoskeletal trauma

Number of injuries and deaths from causes likely to result in musculoskeletal trauma in Ethiopia in 2016



Falls

Incidence: 2,397,889
Deaths: 7,807



Mechanical forces

Incidence: 774,892
Deaths: 2,477



Transport injuries

Incidence: 632,768
Deaths: 14,452



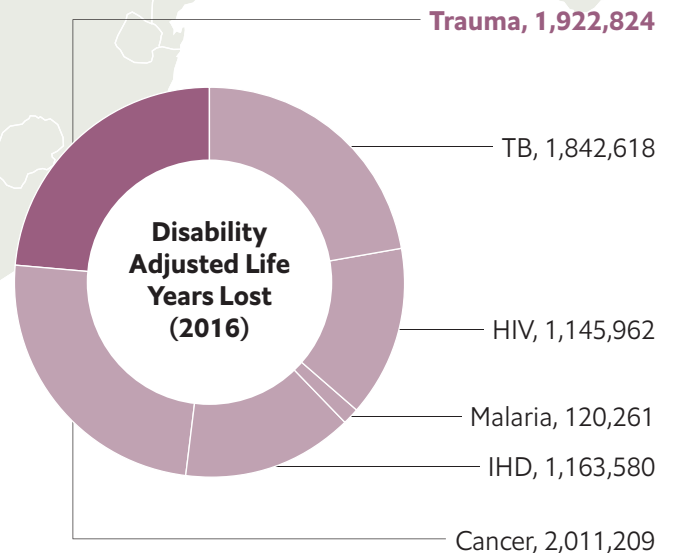
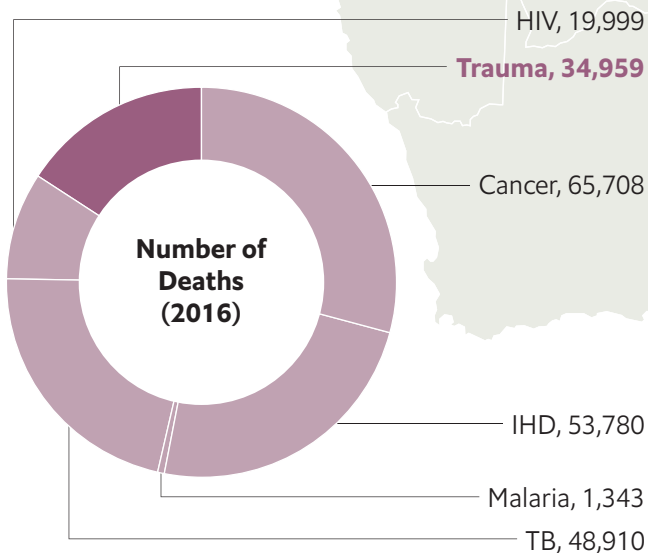
Animal contact

Incidence: 631,470
Deaths: 542



Interpersonal violence

Incidence: 454,630
Deaths: 9,682



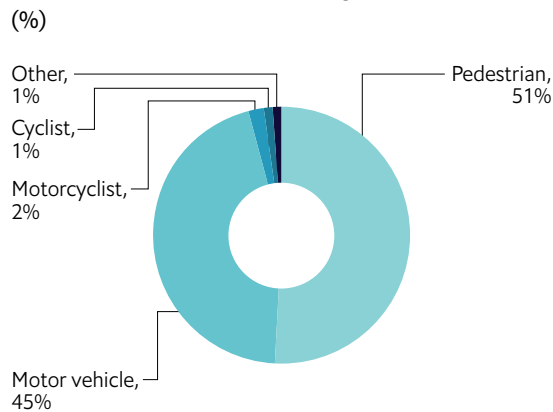
AT BREAKING POINT

UNDERSTANDING THE IMPACT OF MUSCULOSKELETAL INJURIES IN LOW- AND MIDDLE-INCOME COUNTRIES

Case study 2: Ethiopia

Road traffic crashes are the leading cause of death in men aged 15 to 49 years in Ethiopia. There are estimated to be 22.1 deaths related to road traffic crashes per 100,000 population.¹ This is high for a country with a low vehicle ownership rate of 0.95 registered cars in use per 1,000 population,¹¹ but it is said to be due to poor road safety plans and the failure of drivers to abide by the traffic rules.³¹

Figure 6: Mode of transport involved in fatal road traffic crashes in Ethiopia in 2016



Source: GBD 2016.

Pedestrians are most commonly involved in fatal road traffic crashes (11.7 deaths per 100,000 in 2016), followed by motor vehicles (9.7 per 100,000), motorcycles (0.4 per 100,000) and bicycles (0.1 per 100,000) (Figure 6). The rate of crashes involving motorcycles and bicycles is lower than the average rate for low-income countries.¹

A study conducted in an emergency department of one of the main tertiary referral hospitals in Addis Ababa found that over a one-year period, one in 12 emergency admissions were due to road traffic injuries. Out of the 522 road traffic injuries admitted with medical records, the most common injuries sustained were to the lower limbs (36%), followed by head (20%) and upper

limbs (15%). Around a third were fractures and two thirds lacerations. Among the 78 hospitalised cases, 62% were admitted to the surgical department and 16% to the orthopaedic department.³¹

Ethiopia has a high rate of injuries caused by violence. The death rate from interpersonal violence is estimated to be 11.9 per 100,000 population, higher than the average rate of 6.8 per 100,000 for low-income countries.¹ A study of 616 injuries admitted to a tertiary hospital in Gondar over a one-year period found that assault was the most common cause of injury at just over half of all injuries (51.3%), followed by road traffic crashes (30.3%). Fracture (22.9%) and head injury (17.2%) were the most common outcomes of injuries. Injury accounted for 25% of all surgical emergency cases; severe injuries accounted for around 13% of all cases. Out of all the injured patients seen, 30% were admitted and treated in the hospital, 2% died and 13% people were known to experience disability. Where there was follow up data on the type of disability experienced, 42% walked with a limp, 13% were unable to walk and 17% were unable to use a hand or arm.³²

Falls are the biggest cause of injuries likely to result in musculoskeletal trauma in Ethiopia. A cross-sectional study of around 400 building construction workers, again in Gondor, found that 39% had experienced work-related injuries at least once in the previous year, over a third of which were due to falls (37%). None of the workers used personal protective equipment, nor attended any kind of occupational health and safety training.³³

Financial and societal impact

No evidence was found in the literature on the financial and societal impact of musculoskeletal injuries in Ethiopia. However, Dr Samuel Hailu of the Black Lion Hospital in Addis Ababa noted that, like many other developing countries, “when the bread winner sustains the injury everybody in the family gets affected, economically and socially.”

Risk of catastrophic & impoverishing expenditure from surgery

85% of the population of Ethiopia are estimated to be at risk of catastrophic expenditure from surgery (including for injury) and 59% of population are at

risk of impoverishing expenditure (falling below the national poverty line).

Looking at the poorest population only, 98% are estimated to be at risk of catastrophic expenditure from surgery and 100% of population are at risk of impoverishing expenditure.¹⁴

Lost output from injury related deaths

The value of lost output from deaths due to injuries is estimated to result in a cumulative loss of \$25.814 billion in Ethiopia between 2015 and 2030. This number captures loss of productivity and would

translate to an economic loss of up to 0.774% of all economic output by 2030. If welfare losses are incorporated, injuries are estimated to result in US\$5.585 billion or 6.16% of GDP in 2010 alone in Ethiopia. This measure, broader than GDP losses, captures the inherent value that individuals place on their own good health.¹⁷

Current situation and challenges for trauma care

Healthcare financing

Since 2010, the Government of Ethiopia has been phasing in two types of health insurance: community-based health insurance for the agricultural and informal sectors and social health insurance for those employed in the formal sector. When fully implemented, these insurance schemes should cover most households in the country and reduce the currently high out-of-pocket spending for healthcare. It is estimated that less than 20% of the population currently have health insurance.

Total health expenditure in Ethiopia for 2015 was 4.05% of GDP.²⁷ Out of the US\$81 spent on health per person in Ethiopia in 2015, 33% was out-of-pocket spending, 30% development assistance for health spending, 21% government health spending and 16% prepaid private spending.²⁸

Governance and policy

The Ethiopian Ministry of Health has a national plan for trauma care and is committed to improving trauma care services from the scene of the injury through to hospital-based care. Part of the strategy involves supporting the training of trauma and orthopaedic surgeons, setting-up regional hospitals with trauma care expertise and funding surgical instruments for fractures.

AT BREAKING POINT

UNDERSTANDING THE IMPACT OF MUSCULOSKELETAL INJURIES IN LOW- AND MIDDLE-INCOME COUNTRIES

Information systems and registries

There is no established national trauma care registry. Single hospital registries have been set up in the past, such as the trauma registry at the Black Lion Hospital in Addis Ababa in 1999.³⁴ A current initiative, involving the Ministry of Health and Hawassa University among others, plans to establish a trauma registry in Hawassa in combination with a dataset to help assess the effectiveness of non-operative and operative trauma interventions.

Healthcare workforce

Ethiopia has very few trauma surgeons for a population of its large size. It is estimated that there are only around 90 trauma and orthopaedic surgeons covering a population of 105 million, which equates to 0.09 per 100,000 population. Many of these surgeons practice in Addis Ababa, leaving the injured living outside the city with limited access.

However, the situation has been improving through a government initiative to expand the trauma and orthopaedic residency training program over the past eight years. Currently, around 20 residents are trained each year.

Service delivery

Pre-hospital trauma care

A study looking at pre-hospital care among 437 trauma patients treated at the Black Lion Hospital in Addis Ababa found that only 17% of patients received basic pre-hospital care, such as interventions to stop bleeding, positioning of body and immobilisation. Those who did receive care received it from ambulance staff (50%), relatives (30%) or police and bystanders (20%). Taxis were the most commonly used means of transportation to hospital (59%); only one in seven patients were taken to hospital by ambulance and only 19% of patients arrived at hospital within the golden hour of injury. The overall mean arrival time was 117 minutes (ranging from 20 mins to a massive 39 hours).³⁵ Dr Hailu reported that “emergency transportation is the least well covered component of the trauma care pathway.”

Hospital-based trauma care

Most of the rural population in Ethiopia still do not have access to trauma care services. Primary health centres are not equipped to provide trauma care and only a limited number of secondary and tertiary health facilities provide adequate trauma care.³¹ Dr Hailu told us that the main challenges facing trauma care are systemic in nature, including poor organization, communication and coordination. Allied to this are “inadequate budget allocation, a shortage of trained manpower and specialists, a lack of equipment and supplies, and poor emergency infrastructure.”

A trauma care needs assessment meeting in 2015 found that the main issues in Ethiopia are around workforce capacity and training, diagnostic equipment, surgical instruments, and infrastructure. In response to this, a plan has been developed to assist the Ethiopian Government and other partners to establish a sustainable national approach to fracture care. The plan incorporates developing regional hospital facilities to provide safe fracture care, supplying better quality training for surgeons, and developing operating room personnel skills in sterile operative work and care of instruments.

AT BREAKING POINT

UNDERSTANDING THE IMPACT OF MUSCULOSKELETAL INJURIES IN LOW- AND MIDDLE-INCOME COUNTRIES

Rehabilitation

Many injured patients are discharged from hospital without receiving any rehabilitation interventions such as mobility aids and physiotherapy. In Ethiopia disability is commonly associated with a curse and therefore people with disabilities are regularly discriminated against by their family and society. Some charities and private companies provide rehabilitation services, but very few patients in Ethiopia have access to them.

Ghana

Country Snapshot

- World Bank Classification = **lower-middle income country**
- Population = **28.8 million**
- Population aged 15 and under = **39%**
- Population aged 65 and over = **3%**
- Life expectancy at birth (men/women) = **61/63 years**
- Population living in urban areas = **55%**
- Per capita income (PPP) = **US\$4,150 (2016)**
- Current health expenditure as a % of GDP = **5.9% (2015)**
- Economist Intelligence Unit infrastructure rating (10 – good) = **3.4**

The Big Numbers

- **4,982 per 100,000** sustain injuries likely to result in musculoskeletal trauma
- The Economist Intelligence Unit has estimated that **1 in 12** of these injuries will result in musculoskeletal trauma
- **50.4 per 100,000** die from injuries likely to result in musculoskeletal trauma
- **1,879 per 100,000** DALYs are lost from injuries likely to result in musculoskeletal trauma

Number of injuries and deaths from causes likely to result in musculoskeletal trauma in Ethiopia in 2016



Falls

Incidence: 611,002
Deaths: 2,037



Mechanical forces

Incidence: 251,624
Deaths: 713



Transport injuries

Incidence: 185,868
Deaths: 3,825



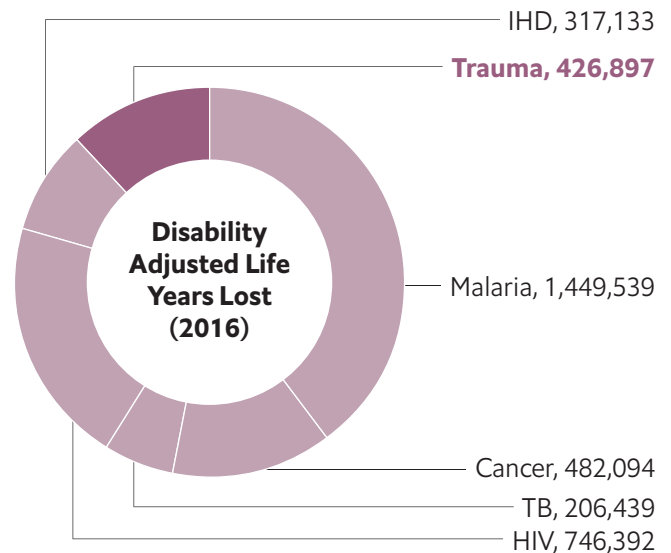
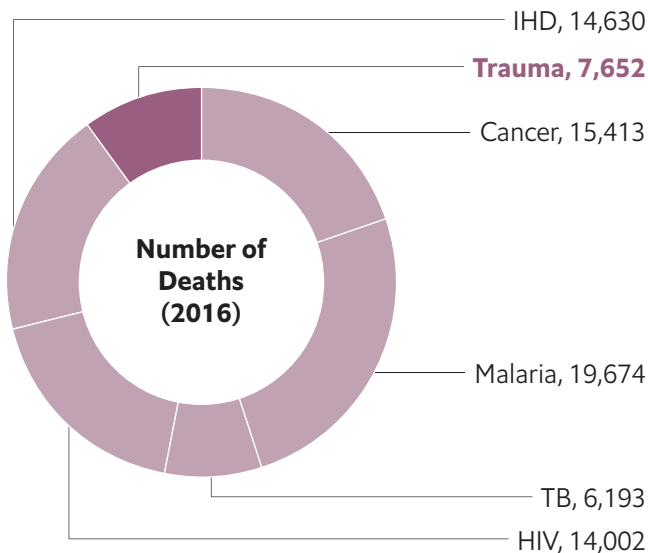
Animal contact

Incidence: 142,936
Deaths: 71



Interpersonal violence

Incidence: 65,469
Deaths: 1,007



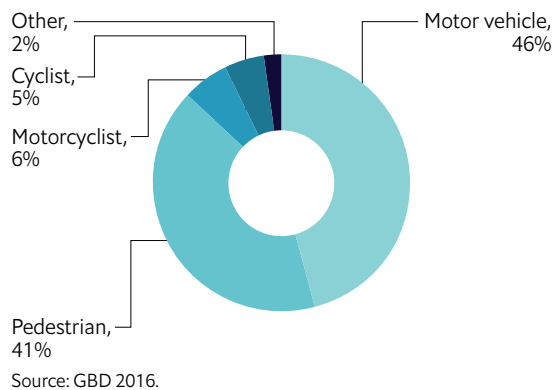
AT BREAKING POINT

UNDERSTANDING THE IMPACT OF MUSCULOSKELETAL INJURIES IN LOW- AND MIDDLE-INCOME COUNTRIES

Case study 3: Ghana

Road traffic crashes are the most common cause of injury-related deaths in Ghana. They are the fourth biggest cause of deaths in men aged 15 to 49 years, after HIV, lower respiratory infection and malaria.¹ Police data show that over a four-year period there were a total of 434,012 road traffic crashes recorded, resulting in 5,276 fatalities, 18,812 severe injuries and 29,695 slight injuries. Just under three quarters of all fatalities were men. Most road traffic fatalities (61.2%) and injuries (52.3%) occurred on roads in rural areas. This was attributed to high driving speeds of poorly maintained passenger-ferrying vehicles on badly deteriorated roads coupled with a lack of emergency medical services in rural areas.³⁶

Figure 7: Mode of transport involved in fatal road traffic crashes in Ghana in 2016
(%)



Motor vehicles are the most common mode of transport involved in fatal road traffic crashes in Ghana (9.2 deaths per 100,000 in 2016), followed by pedestrians (8.3 per 100,000), motorcycles (1.1 per 100,000) and bicycles (1.0 per 100,000) (Figure 7). Crashes from motorcyclists are less common in Ghana compared to other lower-middle income countries.¹

While the absolute numbers of deaths from road traffic crashes have increased from 1,988 in 1990 to 3,635 in 2016, due to an increasing population, the rate of death from road traffic crashes in Ghana has stayed constant, at 20 deaths per 100,000 from 1990 to 2016.¹

A household survey of children aged under fifteen living in two urban communities in Ghana in 2009 found that out of 5,128 children interviewed, 172 of them were involved in a road traffic incident within the previous year, giving a rate of 34 road traffic incidents per 1,000 person-years. Lower extremity injuries represented 58.1% of all injuries followed by upper extremity at 14.5% and head injuries at 9.5%. Over half of all injuries (56%) resulted in a major fracture and 7% resulted in minor fractures. The presence of a fracture was found to be strongly correlated with major disability in children. Of the 163 children who missed at least one day of normal activity, the average length of disability was 29.5 days.³⁷

A larger household survey of 21,105 adults and children living in one urban and one rural area in Ghana in 1995 reported 1,609 injuries resulting in one or more days of loss of normal activity within the previous year. Injury-related mortality was found to be slightly higher in the urban area (83 per 100,000) than in the rural area (53 per 100,000). However, the burden of disability from non-fatal injuries was higher in the rural area (4,697 disability days per 1,000 person-years) than in the urban area (2,671 days per 1,000 person-years). Transport-related injury and falls were the major types of injury sustained in the urban area. However, in the rural area agricultural injuries predominated, followed by falls and then transport-related injury. Non-fatal injuries in both areas primarily involved the extremities, especially the legs.³⁸

AT BREAKING POINT

UNDERSTANDING THE IMPACT OF MUSCULOSKELETAL INJURIES IN LOW- AND MIDDLE-INCOME COUNTRIES

The prevalence of long-term disability due to injury (defined as an injury causing disability of more than one year) was reported to be 0.83%. Two thirds of those reporting long-term disabilities indicated that their disability affected their ability to perform their previous usual activities. Those from urban areas were more likely to access modern medical services (87%) than those in rural areas (66%). Major reasons for not using modern health facilities were preference for other treatments, such as traditional healing (47%) and high treatment cost (24%).^{39,40}

Financial and societal impact

As with other LMICs, few studies have attempted to quantify the social and economic costs to society associated with injury-related death and disability in Ghana. Although it was conducted two decades ago, the 1995 household survey provides the most comprehensive socioeconomic impact assessment. Looking at transport-related injuries only, the survey found that two thirds of those working prior to their injury experienced a loss of income. This averaged at a total of US\$57 (the minimum wage at the time was \$1.50 per day). The mean total loss of working days due to injury was 80.5 days. One third of families reported borrowing money and going into debt as a result of injury, and one third reported a decline in food consumption as a result of injury.⁴⁰

Out-of-pocket medical payments were significantly higher in urban areas (US\$100.05 per transport related injury) compared to rural settings (US\$21.09). At the time of the study, per capita GNP for Ghana per year was approximately US\$400.⁴⁰

Of those who had suffered long-term disability, two thirds indicated that their income had declined because of the injury. One third indicated that they had been forced to borrow money either to pay for medical treatment or to provide for the family and 11% indicated that they had been forced to sell personal property. Almost half of the rural respondents (45%) indicated that food production on their farms had suffered.³⁹

Risk of catastrophic & impoverishing expenditure from surgery

36% of the population of Ghana are estimated to be at risk of catastrophic expenditure (spend on medical care reduces income by 10%) from surgery (including for injury) and 30% of population are at

risk of impoverishing expenditure (falling below the national poverty line).

Looking at the poorest population only, 74% are estimated to be at risk of catastrophic expenditure from surgery and 100% of population are at risk of impoverishing expenditure.¹⁴

Lost output from injury related deaths

The value of lost output from deaths due to injuries is estimated to result in a cumulative loss of US\$6.841 billion in Ghana between 2015 and 2030. This number captures loss of productivity

and would translate to an economic loss of up to 0.457% of all economic output by 2030.

If welfare losses are incorporated, injuries are estimated to result in US\$3.157 billion or 4.33% of GDP in 2010 alone in Ghana. This measure, broader than GDP losses, captures the inherent value that individuals place on their own good health.¹⁷

Current situation and challenges for trauma care

Healthcare financing

Ghana operates a national health insurance system (NHIS) to which 60-70% of the population now subscribe. However, the insurance only covers a small proportion of care, leaving patients to self-fund the majority of costs. Dr Peter Konadu, of Komfo Anokye Teaching Hospital, explained that “the hospital treats every injured patient irrespective of their ability to pay. However, a payment plan must be agreed which can take time, and can lead to bed blocking.”

Total health expenditure in Ghana for 2015 was 5.91% of GDP. Out of the US\$242 spent on health per person in Ghana in 2015, 41% was out-of-pocket spending, 38% government health spending, 17% development assistance for health spending and 4% prepaid private spending.²⁸

Governance and policy

Ghana has a national framework for trauma care, but it is not comprehensive. Hospitals are required to establish their own individual protocols.

Information systems and registries

There is currently no national registry that systematically records trauma patients admitted to hospitals in Ghana. A partnership including the Ghana Government and Ghana College of Physicians and Surgeons has initiated plans to set up trauma registries in Accra and Kumasi.

Healthcare workforce

There are currently only around 40 to 50 specialised trauma surgeons for the entire country, 0.14 to 0.17 per 100,000 population. There are many more general surgeons acting as the first point of call. However, trauma care in Ghana, particularly in rural areas, is often provided in either non-doctor staffed primary health clinics, or district hospitals staffed by general doctors often with little to no formal trauma training and limited capabilities for urgent referral of severely injured patients. A study looking at trauma care training in district hospitals in Ghana found that despite these hospitals treating large volumes of road traffic injuries, none of the doctors or nurses had any trauma training and 30% of the doctors had not even done a rotation in surgery during their training.⁴¹

Dr Wilfred Addo, of Saint Joseph Hospital, Accra suggested that very few doctors are recruited into training mostly due to a lack of adequate funding. He argued that “there needs to be political commitment to increase funding and a mandate to increase training of surgeons. They need to give incentives for training centres to become centres of excellence.” There are also problems with the so called “brain drain”—losing doctors to developed countries. It has been reported that 69% out of the 871 medical officers trained in Ghana between 1993 and 2002 now practice overseas.⁴²

However, international funding has enabled an initiative to strengthen the trauma care workforce through creating two additional trauma and orthopaedic residency centres. A training school has also been established for plaster assistants, setting-up operating room personnel courses, and training general surgeons in fracture care for simple fractures and referral of complex fractures.

AT BREAKING POINT

UNDERSTANDING THE IMPACT OF MUSCULOSKELETAL INJURIES IN LOW- AND MIDDLE-INCOME COUNTRIES

Service delivery

Pre-hospital trauma care

Ghana has a high rate of injury victims dying before they reach hospital. A study comparing trauma mortality patterns among countries showed that 81% of all trauma deaths occurred before reaching hospital in Ghana. This compares to 59% in the USA.⁴³ An ambulance system does exist, but there are only around 55 operational ambulances for a population of 28.8 million, meaning that most Ghanaians do not have access to them. Also, many areas such as slums are difficult to access, and there have been reports of people being asked to pay to use ambulances, despite being covered under the NHIS.

Hospital-based trauma care

Hospital mortality rates for patients with life threatening, but treatable injuries in Ghana are six times higher than those in the USA.⁴³ There are many reasons for this difference, including poor infrastructure, lack of equipment and consumables either due to high cost or a lack of organisation or planning. Add to this a limited availability of specialist staff, poor system organisation and access to care, and it is evident investment is needed. Dr Wilfred Addo of Saint Joseph Hospital, Accra, tells us that “Political commitment is needed to ensure that that all major health facilities are equipped as trauma centres to care for the injured patients.”

However there have been some recent improvements. A study assessing trauma care capacity in Ghana in 2014 found significant improvements at both district-level and regional hospitals over the last decade, but critical deficiencies remained, mostly in absence of equipment, supplies and insufficient training.⁴⁴ “Equipment and consumables are very expensive”, reported Dr Peter Konadu, of Saint Joseph Hospital, Accra. Furthermore, “maintenance is not done regularly so the equipment breaks down frequently and power cuts can damage the equipment.”

Complicating the issue is that fact that up to 78% of all patients with fracture resort to traditional bone setters. Reasons for this include the high cost of modern treatment, fear of amputation and the belief that every misfortune has a spiritual undertone. Patients with fractures initially taken to clinics or hospitals often discharge themselves to see bone setters, only to return with complications. A prospective study following-up 230 patients with complications after seeing a bone setter in Ghana found that just over half of the patients had malunion (heals in an abnormal position) or nonunion (fails to heal) fractures and 17% suffered infections.⁴⁵ As part of a project to improve fracture care in children in Ghana, the Ghana College of Physicians and Surgeons is attempting to develop an outreach program aimed at traditional bone setters to train them in first aid and fracture care.

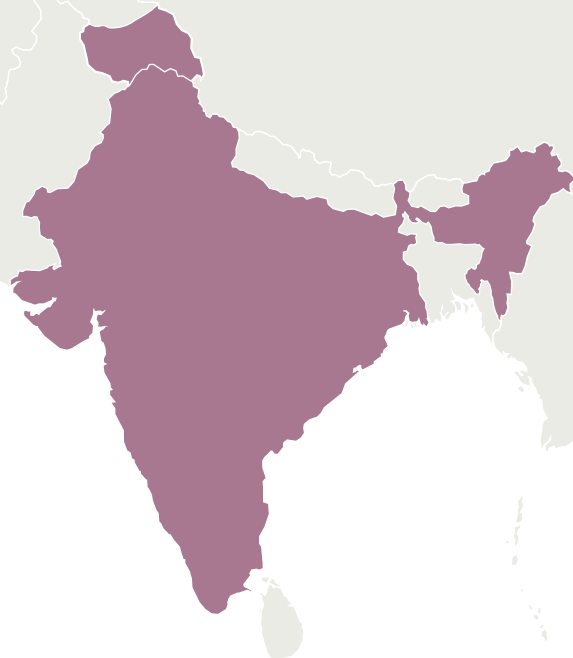
Rehabilitation

As with many other LMICs, rehabilitation services are very limited and unaffordable to most Ghanaians. Dr Konadu told us that “very few people can afford to access rehabilitation services”.

India

Country Snapshot

- World Bank Classification = **lower-middle income country**
- Population = **1.353 billion**
- Population aged 15 and under = **29%**
- Population aged 65 and over = **6%**
- Life expectancy at birth (men/women) = **67/70**
- Population living in urban areas = **33%**
- Per capita income (PPP) = **US\$6,490 (2016)**
- Current health expenditure as a % of GDP = **3.9% (2015)**
- Economist Intelligence Unit infrastructure rating (10 – good) = **3.2**
- Passenger cars = **21 registered cars in use per 1,000**



The Big Numbers

- **6,407 per 100,000** sustain injuries likely to result in musculoskeletal trauma
- The Economist Intelligence Unit has estimated that **1 in 5** of these injuries will result in musculoskeletal trauma
- **58.4 per 100,000** die from injuries likely to result in musculoskeletal trauma
- **2,368 per 100,000** DALYs are lost from injuries likely to result in musculoskeletal trauma

Injuries likely to result in musculoskeletal trauma = transport, falls, physical violence, exposure to mechanical forces and non-venomous animal contact injuries

Number of injuries and deaths from causes likely to result in musculoskeletal trauma in India in 2016



Falls

Incidence: 37,639,512
Deaths: 213,195



Transport injuries

Incidence: 15,328,700
Deaths: 286,525



Animal contact

Incidence: 13,788,968
Deaths: 2,882



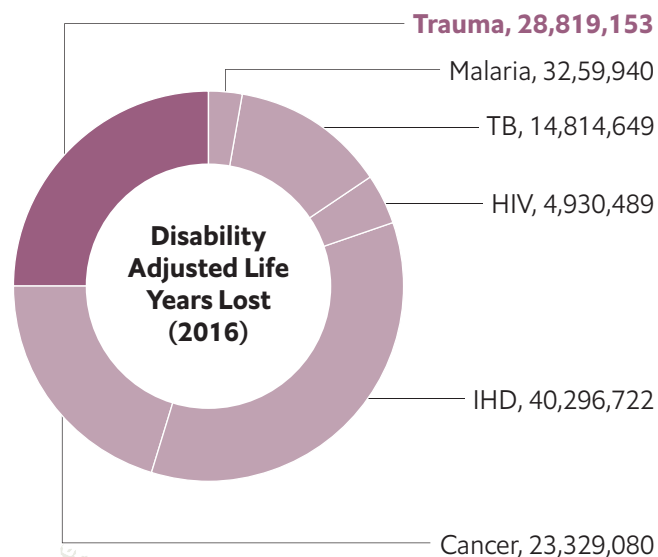
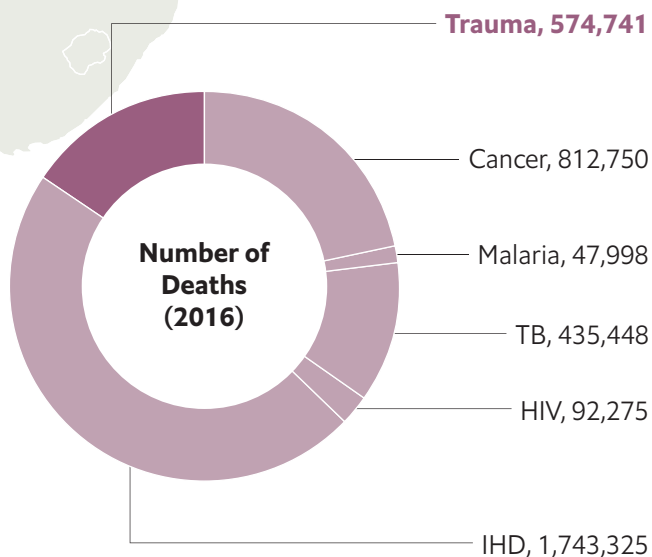
Mechanical forces

Incidence: 8,135,326
Deaths: 23,560



Interpersonal violence

Incidence: 2,866,877
Deaths: 48,579



Case study 4: India

Road traffic crashes are the number one cause of death in 15 to 29 year old men in India and the eighth biggest cause of death across the whole population.¹ The Million Death Study, a large nationally representative verbal autopsy household study, found that road traffic crashes were the biggest killer in men in both urban and rural areas, but to a greater extent in urban areas (23.6% of deaths in urban areas compared to 21.4% in rural) (see Table 1).⁴⁶

Table 1: Top 10 causes of death in age 15-29 years in rural & urban areas in 2010-2013

Rank	Cause of Death	Deaths (%)		
		Male	Female	Person
Rural Areas				
1	Intentional injuries: Suicide	16.0	22.6	18.9
2	Unintentional injuries: Motor Vehicle Accidents	21.4	3.0	13.2
3	Unintentional injuries: Other than Motor Vehicle Accidents	12.9	9.6	11.5
4	Cardiovascular diseases	7.4	6.8	7.2
5	Digestive diseases	6.7	6.8	6.7
6	Tuberculosis	4.8	5.0	4.9
7	Malignant and other Neoplasms	4.3	5.2	4.7
8	Maternal conditions	-	9.2	4.1
9	Diarrhoeal diseases	2.8	5.1	3.8
10	Malaria	3.4	4.2	3.7
	All Other Remaining Causes	20.3	22.5	21.3
	Total	100	100	100
Urban Areas				
1	Unintentional injuries: Motor Vehicle Accidents	23.6	4.4	15.3
2	Intentional injuries: Suicide	11.6	18.7	14.7
3	Unintentional injuries: Other than Motor Vehicle Accidents	10.3	6.8	8.8
4	Digestive diseases	9.3	7.9	8.7
5	Cardiovascular diseases	9.5	7.5	8.7
6	Tuberculosis	5.4	6.5	5.9
7	Malignant and other Neoplasms	4.4	5.4	4.8
8	Diarrhoeal diseases	3.0	5.0	3.9
9	Maternal conditions	-	8.1	3.5
10	Other infectious and parasitic diseases	2.8	4.1	3.4
	All Other Remaining Causes	20.0	25.6	22.4
	Total	100	100	100

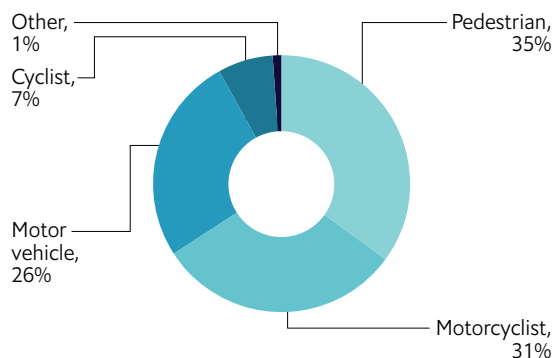
Source: Million Death Study

Pedestrians are most commonly involved in fatal road injuries (8.0 deaths per 100,000 in 2016), followed by motorcycles (6.1 per 100,000), motor vehicles (5.5 per 100,000) and bicycles (1.5 per 100,000) (Figure 8).¹

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Figure 8: Mode of transport involved in fatal road traffic crashes in India in 2016
(%)



Source: GBD 2016.

In the last few years the number of deaths from road traffic crashes in India has remained relatively constant and the rate has declined slightly from 20.2 deaths per 100,000 in 2012 down to 19.3 deaths per 100,000 in 2016.¹ However, anecdotal evidence suggests that the nature of injuries is getting worse. Dr Nobhojit Roy, a trauma surgeon at a government hospital in Mumbai reported that “injuries are getting nastier and harder to save with cars getting bigger and faster and the roads not being suitable for them.”

A dated, but large urban household survey of 30,554 people sustaining 2,232 major injuries either

affecting work or requiring treatment in Delhi in 2002 found:⁴⁷

- An annual incidence of 73.1 injuries per 1,000 population (morbidity 62.5; disability 9.0, and mortality 1.5 per 1,000).
- Injuries were four times more likely to occur in men.
- Falls were the largest cause of injuries (38%) followed by traffic (31%), mechanical injuries (11%), burns (8%) and animal bites (7%).

Out of the 680 road traffic victims recorded in the study the investigators recorded that:

- Limbs were the most affected parts of the body (41.3% lower limbs and 20.9% upper limbs) followed by the head (11.2%).
- Superficial injuries were found to be the most common (47.4%) in traffic injuries, followed by fractures (20.7%), crush injuries (14.1%) and concealed injuries (12.4%).
- Auto-rickshaws or taxis (35.7%) were the most commonly used mode of transport to reach the health facility, followed by bicycles (9.4%), ambulances (4.9%) and public transport (4.1%).
- Most injured victims (92.4%) reached treatment within six hours; 70.0% arrived within one hour of injury.
- The majority were treated in a nearby private clinic (44.4%), followed by government hospitals (26.8%) and private hospitals (16.0%).
- 9.0% of victims were in critical condition; 5.9% were hospitalised, 1.8% were operated upon, and 1.3% were admitted to ICU.
- Most injured victims resumed work within 2-4 days of injury (19.3%), followed by 5-7 days of work loss (14.7%), while 13.4% could not resume normal work for 1-2 months.

Financial and societal impact

Few studies have attempted to quantify the social and economic costs to society associated with injury-related death and disability in India. A survey of 96,414 people in 19,797 households in rural, urban and slum areas in Bangalore assessed the impact of road traffic accidents on poor households and found that the poor spend a much greater proportion of their income on medical and/or funeral costs than the non-poor.⁴⁸ Fewer poor people were able to return to their previous employment and most poor households went into debt by borrowing money to cope with the additional costs and lack of income following a road crash. Some also reduced their financial security by selling an asset. Consequences included reduced household income and reduced food consumption for the victim's family. A large number of poor households post-crash were estimated to have not been poor before the crash.⁴⁸

Dr Nobhojit Roy of the BARC Hospital, Mumbai, noted a now familiar refrain: "Trauma is a poor man's disease. Poor men walk, bike and take the train. It's a male problem and the average age is that of a productive individual who would typically have a child or two to support. They are the single bread winner. Injuries are the largest creator of poverty. Costs are enormous. DALYs are enormous as injuries cause disability at a young age"

Risk of catastrophic & impoverishing expenditure from surgery

60% of the population of India are estimated to be at risk of catastrophic expenditure (defined as spend on medical care reducing income by 10%)

from surgery (including for injury) and 36.5% of population are at risk of impoverishing expenditure (falling below the national poverty line).

Looking at the poorest population only, 90% are estimated to be at risk of catastrophic expenditure from surgery and 100% of population are at risk of impoverishing expenditure.¹⁴

Lost output from injury related deaths

The value of lost output from deaths due to injuries is estimated to result in a cumulative loss of US \$1100 billion in India between 2015 and 2030. This number captures loss of productivity and would

translate to an economic loss of up to 0.925% of all economic output by 2030.

If welfare losses are incorporated, injuries are estimated to result in \$485 billion or 8.85% of GDP in 2010 alone in India. This measure, broader than GDP losses, captures the inherent value that individuals place on their own good health.¹⁷

Current situation and challenges for trauma care

Healthcare financing

Healthcare is delivered in public and private hospitals. Public healthcare is free for those below the poverty line. However, most healthcare is delivered from private hospitals, and the private sector provides nearly 80% of outpatient care and about 60% of inpatient care. Private insurance remains out of reach for all but the wealthiest Indians, so many patients must pay out-of-pocket for their treatment.

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Total health expenditure in India for 2015 was 3.89% of GDP. Out of the US\$236 spent on health per person in India in 2015, 64% was out-of-pocket spending, 26% government health spending, 9% prepaid private spending and 1% development assistance for health spending.²⁸

Governance and policy

India has a national trauma care policy, but it is not fully operational nationwide. The National Health Policy for 2017 makes various recommendations for improving trauma care, including that for every 100,000 people, 200 beds are kept exclusively for receiving trauma patients within one hour of the trauma (‘golden’ hour). It also recommends a unified emergency response system be developed that is linked to a dedicated universal access number, with an emergency care network of life support ambulances and trauma management centres (one per 3 million people in urban areas and per 1 million in rural areas). The Indian Government has also proposed a plan to build 140 trauma hospitals along the golden quadrilateral, a national highway network connecting Mumbai, Delhi, Kolkata and Chennai.⁴⁹

Information systems and registries

There is currently no national registry that systematically records trauma patients admitted to all hospitals in India. A multi-hospital trauma registry has recently been successfully piloted in four large trauma centres in Mumbai, Delhi, Calcutta and Chennai using independent data collectors. It is the largest trauma registry in India with around 16,000 serious cases. It doesn’t include single bone trauma and mainly focusses on mortality, but it is a useful start.

Healthcare workforce

There are very few specialist trauma surgeons working in India, with only around 10 to 15 in total. However, there are many more orthopaedic surgeons and other specialist surgeons who are involved in trauma response. In the absence of dedicated trauma surgeons, it can be unclear who takes clinical responsibility for trauma patients. This can delay clinical decisions, putting trauma patients at greater risk.⁵⁰

Dr Roy suggests that health professionals don’t want to be trauma surgeons because there’s “no money in it” compared to other emergency specialties such as cardiology and obstetrics and gynaecology. He goes on to say that “Cardiac patients are more attractive—typically, a 60-year-old man, has money, brings his wallet. Whereas a trauma patient is typically an 18-year-old motorcyclist, loses consciousness, loses his identity, left to society”. Consequently, trauma patients tend not to be accepted by private hospitals, so they’re taken to a public hospital. Even if there is a small charge for a scan, Dr Roy says, there is “nobody to pay”.

Service delivery

Pre-hospital trauma care

There is limited on-the-scene care and ambulance transport across India. Pre-hospital care varies widely in India between urban and rural settings, and between rich and poor patients. Certainly, pre-hospital care is mostly absent in rural and semi-urban areas in India, and implementation of the ‘golden hour’ concept remains an unachieved goal. No national or regional guidelines exist for pre-hospital care, triage, patient-delivery decisions, or transfers.⁵⁰

A study looking at police registered road accidents (486 fatal incidents and 2,377 non-fatal) in a rural

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state in India in 2011 found that 46% of deaths occurred at the crash site and 17% died on the way to hospital. A large proportion of injured patients still rely on private transportation (motorcycles or auto-rickshaws) to get to hospital, and the majority visit smaller health centres before reaching the district hospital, which can delay care.⁵¹

A survey of trauma care systems in India conducted in 2002 found that of the 50 institutions surveyed, 12% reported having no ambulance service, and of those with ambulances, a third were only transport vehicles with no paramedic staff. Only half of ambulance services staff reported having the skills and resources for providing airway support or splinting a broken limb. A literature review of trauma care studies in India found a median time from injury to arrival at hospital of 3 hours across 14 urban hospitals. Across six studies, all conducted in urban areas, on average only 4% of patients were transported to hospital by ambulance and 15% received pre-hospital care.⁵² “In India the golden hour is more like the golden day or even week. Patients go to smaller hospital first, then move along to bigger. It takes a long time”, remarked Dr Roy.

Hospital-based trauma care

A series of studies looking at in-hospital mortality patterns in trauma patients in four urban hospitals in India found that a fifth of trauma patients (21.4% of 11,209 patients) died within 30 days of being admitted to hospital, double the mortality rate observed in trauma centres in high-income countries. Seven percent of patients died within 24 hours, 9% between 1 and 7 days and 5% between 8 and 30 days. More than half of the in-hospital trauma deaths were thought to be preventable, with inadequate fluid resuscitation and haemorrhage control being the leading causes of preventable deaths. A lack of protocols, adherence to protocols, pre-hospital delays and delays in imaging were the main system-related issues found.⁴⁹

According to Dr Roy, efforts to improve the trauma care pathway should begin in the hospital. He exclaims that “we’re not even able to save the people that reach the hospital. Over half of road traffic victims die in hospital. Even with faster ambulances, patients would still die in the hospital.” Dr Roy has a clear plan though. His top recommendations for improving hospital-based trauma care in India are to train and empower nurses to undertake trauma triage, set up a national trauma-registry, transform the current major teaching hospitals into major trauma centres and set up preventable death panels and working groups.

Rehabilitation

Rehabilitation is the most poorly covered part of the trauma pathway in India. It is restricted just to physiotherapy in most facilities. A survey of 50 facilities across India in 2002 found that three quarters offered physiotherapy services, a third offered occupational rehabilitation and psychological counselling and 14% offered social rehabilitation. Rehabilitation is not well integrated with the rest of the healthcare system, as only weak links and transfer agreements were found between acute facilities and rehabilitation units.⁵⁰

How can health systems respond?

It is evident from the case studies that trauma care systems in many LMICs are fragmented, inaccessible and often only offer poor quality care. However, research suggests that well organised trauma systems can reduce mortality by 15–20%.⁵³ There are innovative approaches happening in trauma care systems in LMICs across the globe. We look at some examples here.

There are three essential steps in any trauma care system. They are 1) the care delivered at the scene of the incident, 2) transport to and the care provided in the hospital, and 3) any necessary rehabilitation. While the WHO has created an Emergency Care System framework^(a) as guidance to improve care and save lives, many LMICs do not have the resources for formal trauma systems. However, innovative approaches to care can improve outcomes. Training bystanders to provide immediate care, making infrastructural changes to reduce waiting times and teaching patients to manage and maintain their own rehabilitation can all help to reduce mortality and lasting effects from injuries.

Pre-hospital care is an effective platform for reducing trauma deaths

While pre-hospital care is effective it isn't widespread, leaving much of the world's population without access to it.⁵⁴ In LMICs, many individuals who die from trauma related deaths die before reaching the hospital, leading to high numbers of preventable deaths. Care systems in developing countries are often based on training community members and non-medical professionals to provide a basic level of pre-hospital care to people who are seriously injured.⁵⁵

However, while the care being offered may be relatively basic, improvement in training and education can significantly improve initial care. Studies have found that including laypersons into trauma care systems is both clinically and economically successful.⁵⁶ For example, in Ghana, where most of the severely injured that make it to a hospital are transported in commercial vehicles such as taxis and buses, an educational programme provided commercial drivers with first aid training to reduce the risk of mortality at the scene. When evaluated, 61% of those interviewed indicated that they had provided first aid since taking the course, with evidence of improvement in the type of first aid they provided.⁵⁵

In India, a two-day training program in Rajasthan consisting of video lectures for first responders in their native language increased understanding and skills in all essential aspects of pre-hospital management in 112 participants.⁵⁷ A further study testing rural pre-hospital trauma system models in LMICs was conducted in northern Iraq and Cambodia. Here, between 1997 and 2001, 135 local paramedics and 5200 first lay responders were trained to provide local trauma care. The results found that the trauma mortality rate was reduced, and every year, treatment outcomes improved.⁵⁸

At a larger scale, successful emergency medical services can be set up in LMIC settings. A study investigating the utilisation and effectiveness of a trauma system in rural Uganda found that the newly established system proved to be affordable and highly utilised by trauma patients.⁵⁹ In Brazil, the creation of a pre-hospital system in an urban setting reduced the rate of mortality from motor vehicle crashes. Deaths within the first hour of the incident fell to 41% from 54%.⁶⁰

(a) http://www.who.int/emergencycare/emergencycare_infographic/en/

Patients continue to die from medically preventable causes due to a lack of effective hospital-based trauma care

Hospital-based care combines human resources, physical resources and the care process itself.⁶¹ In many LMICs, patients often die from medically preventable causes due to a lack of effective hospital-based trauma care. The shortage of infrastructure and human resources, inaccessibility of acute interventions and lack of life-saving equipment limit health care facilities in providing effective care for injured people.^{56, 62, 63}

An essential component of hospital-based care is effective system organisation. A study of comparable trauma centres in China and the USA found that centre designation and system organisation interventions could reduce injury mortality.⁵⁶ Similarly a comparison of trauma care in the USA, Mexico and Ghana concluded that a sustained infrastructural change has potential to reduce deaths and disabilities.⁵⁶

Clinical protocols provide healthcare workers with guidance. They are particularly significant in low resource settings where clinical teams are small and junior clinicians may be given little supervision.⁵⁶ In Colombia, the introduction of Standardised Trauma Protocols (STPs) lowered mortality rates, reduced length of stay for surgical and non-surgical cases and increased the use of interventions such as vaccinations and administering antibiotics.⁶⁴

Trauma patient needs vary depending on the type and severity of the injury. Consequently, the most effective care will be delivered by multidisciplinary teams. A university hospital in Thailand set up a rapid response trauma team which successfully reduced the mortality rate from thoracic injuries and improved the outcomes of maxillofacial, head and orthopaedic injuries.^{56, 65}

Much of the disability from injuries in LMICs is potentially preventable through inexpensive improvements in rehabilitation

Rehabilitation focuses on improving the recovery of independent function of people with injuries after the acute treatment phase is over.⁶¹ According to the WHO guidelines for essential trauma care, “much of the disability from extremity injuries in developing countries should be preventable through inexpensive improvements in orthopedic care and rehabilitation.”⁶¹ Dr Gosselin, from the University of California in San Francisco, agreed with this assessment, stating that “the importance of rehabilitation is very overlooked. Quality of life after surgery studies are almost non-existent in LMICs. Nobody thinks about this”.

Delays in rehabilitation can result in people suffering from preventable complications.⁶⁶ Like all stages of the trauma system, effective services can be delivered across multiple platforms including the community, primary health centres and inpatient hospitals.⁶⁶ However, services are rarely delivered anywhere in LMICs, and Professor Mock argues that rehabilitation is the most neglected area of the trauma system. It is the “one specific area which appears even more neglected than the rest.”

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Case studies that do exist for rehabilitation tend to be based around integrating rehabilitation care, training patients and their care providers and providing the injured with equipment to help with their recovery process. In Brazil, a rehabilitation team was set up in a busy acute care hospital; patients suffering from severe injuries were seen to as soon as they were admitted, and rehabilitation was started as soon as possible. Family members and patients were trained on how to self-care to maintain the rehabilitation process and reduce long term effects from the trauma.⁶⁷

In another example, in Gujarat, a state in India, an earthquake left many with paraplegia, driving the need for rehabilitation services. A training programme taught patients basic self-care and sustainable support systems were set up for those with disabilities. The programme resulted in five-year mortality rates among paraplegic people falling to 4% from 60%.⁶⁷

Conclusions and recommendations

Injuries are a neglected epidemic in LMICs. They disproportionately affect the poor, with 83% of the 4.6 million global deaths occurring in developing countries. Deaths from injuries among LMICs worldwide are higher than from TB, malaria and HIV combined. However, they continue to receive comparatively little funding despite being largely preventable through injury prevention schemes, simple emergency procedures at the scene and timely access to good quality trauma care systems. It has been estimated if all-cause injury mortality in LMICs was reduced to the level seen in high-income countries, more than two million lives, 50 million DALYs, and US\$786 billion could be saved each year.¹⁸

Poor data is a common problem across LMICs, particularly for musculoskeletal injuries—the most common injury requiring medical attention. Very little research has been conducted on the burden of injury in LMICs, let alone on the longer-term consequences and wider impact on society. As highlighted by the case study countries, most of the evidence is limited to small, often retrospective, hospital-based case series; few LMICs have comprehensive trauma registries and death registration systems. The GBD Study offers the most robust estimates of burden of cause-specific injuries, with data on incidence, deaths and DALYs, but their estimates for LMICs are based on limited data and there is no detail provided on the nature of the injury sustained.

Delayed access to trauma care is as catastrophic as it is widespread. This can be due to several factors including cultural beliefs, poor education and a preference for traditional healers. In addition many LMICs have limited emergency response and transportation, or poorly equipped community hospitals with slow referral systems to specialist centres. The review of the case study countries has highlighted additional problems, including inadequate infrastructure, workforce, equipment and supplies to perform essential radiological, anaesthetic and surgical services. We've also found evidence of poor overall system organisation and local leadership, little to no rehabilitation care, and, at a wider level, corruption.

Despite these challenges, there is a great deal that can be done to improve the neglected burden and impact of death and disability from injuries in LMICs. Naturally, systems of trauma care will have to be as diverse as the populations they serve, and each innovation must be made in the context of a country's cultural, socioeconomic, political, demographic, and epidemiological environment. Nevertheless, certain themes and systemic needs emerged repeatedly during our research.

The way forward

1. Improve the understanding of burden of injuries through surveillance and registries

LMICs need to set up comprehensive trauma registries to measure and track the burden of injuries, improve quality of care and help measure the effectiveness of interventions. As noted by Dr Gosselin, “you cannot measure your impact unless you know your baseline.”

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There are several examples of registries being successfully run in LMICs, but they are often short-lived and only run from one hospital. Efforts should be made to set-up on-going and inter-linked registries that systematically record data on demographics, mechanism of injury, pre-hospital care information, vital signs, diagnoses, severity of injury, procedures performed, outcome, length of stay, complications, and data on costs and resource utilisation. India and Cameroon are in the process of doing this and countries should look to them to see how this can be done in an affordable and sustainable manner. Equity of care should also be studied to understand existing disparities as well as their root causes in order to better devise solutions.

There is also a need for epidemiological studies in the form of household surveys and prospective cohort studies to provide a comprehensive, population-based estimation of the burden of treated and untreated injuries and to look at longer term outcomes and the wider socioeconomic impacts. Professor Mock explained that “we need more systematic information from multiple hospitals regularly supplemented with data from household surveys as needed.” These studies can be costly and time consuming, so LMICs may need to look to the international community for funding and expertise support.

2. Reclaim the golden hour; small improvements to pre-hospital care can have large outcomes

The golden hour (or golden time) is the period immediately following a traumatic injury during which prompt care is mostly likely to prevent death and reduce morbidity. Getting fast, appropriate care to trauma victims is crucial. However, in many LMICs accident victims suffer delays. For example, in many LMICs it is rare for injured patients to be transported by ambulance, having to rely on public transport instead. A telling quote from Dr Roy was that “in India the golden hour is more like the golden day or even week”, as patients move slowly from smaller clinics to larger institutions that have the necessary expertise and capacity.

Needs will vary by country, but the evidence base has shown that innovative pre-hospital care systems can vastly improve initial care. For example, simple but effective training of paramedics and laypersons—such as taxi drivers and other early responders—can reduce trauma mortality. In the medium to longer term, investment is required in properly staffed emergency medical services and effective referral systems.

3. Simple rehabilitation measures will speed recovery, reduce morbidity, and ultimately save money

Rehabilitation focuses on improving functional recovery after treatment. Delays or poor practices can result in people suffering from preventable complications. The need here is not for expensive equipment, but rather for training and awareness—ultimately rehabilitation success relies upon the skills of the caregivers.

“One specific area which appears even more neglected than the rest is rehabilitation” said Professor Mock. And as with the golden hour, evidence suggests that small changes can have a dramatic impact. One of the most successful interventions is the training of patients and their care providers—including family members—in essential techniques to improve their capacity for self-care. Alongside this is the need for improvement in availability and distribution of the necessary equipment to help with their

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recovery process, as well as making care more affordable. Such interventions can be driven by the establishment of rehabilitation teams, either set up directly in hospitals or ideally in smaller clinics.

4. A horizontal, systems-based approach to improving trauma care is required

“Managing musculoskeletal injuries needs to be system based,” said Dr Gosselin. And indeed, there was widespread agreement that there is a need to improve the organisation and planning of trauma systems that address all aspects of care, from the pre-hospital setting all the way through to longer term rehabilitation. The WHO guidelines on the core essential trauma care services and the emergency care system framework are a good place to start.

Dr Gosselin went on to explain that “the systems approach means you need anaesthesia for musculoskeletal injuries, but also this is needed for obstetrics or any kind of surgery. You need operating rooms, staff and equipment for all kinds of surgery.” “The only way to be sustainable is to create horizontal, integrated and comprehensive systems”

Therefore, the systems-based approach to improving trauma care must look across all surgical specialties, not just injuries. Professor Mock stated that “it’s necessary to decrease the burden of musculoskeletal injuries more systematically in each country, including how to achieve that with the most effect per population; this includes wider distribution of skills in a thought-out manner, not haphazardly.”

Governments and their ministries have a role to play here. They need to think and plan in a systems manner. Not only should they allocate resources and set health standards and guidelines, but also encourage collaboration and co-ordination, raise public awareness, and fully reimburse health facilities for the care of the poor.

5. Without political will, nothing will change; engage politicians and policy makers to ensure injuries are made a national priority

“If you don’t have political will nothing will change”, were the words of Dr Gosselin, echoing those of other interviewees. Many LMICs lack governmental direction on trauma care and do not have operational national trauma policies in place. Ministries of Health should look to develop a national trauma plan, with ownership from all the key stakeholders, covering prevention, emergency care, trauma care and rehabilitation.

Also, cross-sector innovation is required. The development of trauma care in LMICs can require financial investment, participation, research, education, advocacy, innovation, and entrepreneurship. Active government is needed to facilitate these complementary activities. For example, Dr Lekina argued that Cameroon needed to make a start by “having a consensus conference in trauma care where the ministry and practitioners sit down and create a road map in terms of teaching, equipment and rehabilitation needed. It will not work if everyone is not on board.”

6. Advocate for change; investment in trauma care means investment in the wider healthcare system

“We try our best, but with a lack of equipment and trained staff there is only so much we can do.” A message that repeatedly came through from our interviewees and the wider literature is that there are significant shortages in many parts of the world of trained staff, equipment and supplies. These issues have existed for years. While elements of the recommendations listed above can be implemented

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without the need for significant investment, there is no escaping from the fact that staff and equipment cost money.

Campaigns to improve surgical provision in LMICs (such as Global Surgery 2030 and the activities of the Lancet Commission on Global Surgery), and efforts to ensure that safe surgery is embedded in SDG 3^(b), offer a route for international injury advocates to make the case that improving trauma care will also improve the provision of healthcare for the population. The case needs to repeatedly be made that such activity is an investment, not a cost. The topic may not yet be fashionable, but there is still time to find a celebrity benefactor who can be the voice for those who are suffering.

(b) Sustainable
Development Goal 3:
Ensure healthy lives
and promote wellbeing
for all at all ages

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Appendices

To investigate the burden and impact of musculoskeletal injuries, current challenges facing trauma care systems and effective interventions to improve trauma care in LMICs, the Economist Intelligence Unit conducted a literature review and performed eight interviews with local and international experts.

Literature review

For the literature review we searched published and grey literature to identify relevant academic studies and reports on the incidence, mortality, morbidity and socioeconomic impact of musculoskeletal injuries, current situation of trauma care systems, and the effectiveness of interventions to improve trauma care in LMICs and the case study countries.

The search was pragmatic, iterative and targeted in scope, and was carried out by an experienced health information specialist. References were managed in Endnote. The basic search from which further complementary searches were developed ran:

1. 'burden'/exp OR burden OR 'impact'/exp OR impact OR 'incidence'/exp OR incidence
2. trauma* OR accident* OR injur* OR 'injury'/exp
3. orthopaedic OR orthopedic OR musculoskeletal OR 'musculoskeletal system'/exp
4. ('low income' OR 'middle income' OR developing OR africa* OR asia* OR poor) AND countr* OR 'developing country'/exp
5. india:ti OR cameroon:ti OR ghana:ti OR ethiopia:ti
6. #1 AND #2 AND #3 AND (#4 OR #5) AND [2008-2018]/py

In addition to database searches we conducted grey literature searches, including searches of relevant organisations' websites. Supplemental search techniques such as reference harvesting and citation searching were used to identify further research reports from "pearl" articles.

Case studies

Case studies were performed for Cameroon, Ethiopia, Ghana and India using data from the literature review and interviews. We summarised the burden and impact of musculoskeletal injuries and the challenges currently facing trauma care for each country.

Primary research

We interviewed six trauma surgeons in the case study countries (two interviewees provided written answers to our interview questions) and two international experts. Interviews were semi-structured in nature, with one questionnaire for the local trauma surgeons and one for the international experts. Transcripts were made for all of the interviews. Direct and indirect quotes from the interviewees are used throughout the report.

We have summarised the data using the most recent information available to us. We have made every effort to ensure that the information is correct at the time of writing—September 2018.

Methodology for calculating the annual impact of injury on LMICs

To quantify the annual estimated indirect impact of injuries on LMICs we calculated the costs in two parts; the cost to the economy from working people dying and the cost from working days lost due to injury. We took the list of countries from the WHO's definition of low- and middle-income countries^(c) and have calculated the impact for 128 of the 137 listed countries. The data for number of deaths and incidence for injuries in 2016 came from the Global Burden of Disease¹. Data for the labour participation rate and labour force came from the International Labour Organisation^(d) and GDP and population figures were obtained from the Economist Intelligence Unit database.^(e)

Total costs for 2016 summed to US\$180.2 billion for the 132 countries that data was available for. We believe that this is a reasonable estimate given the economic losses from road traffic injuries was estimated to be US\$100 billion^{68, 69} and our figure includes other types of injuries.

We understand that the calculations are based on several assumptions, starting with the idea that injuries are evenly distributed between workers and non-workers whereas a larger proportion of the burden probably falls on working aged people. Using the same number of days lost due to injury and working days in each country will have an impact on the costs. Calculating GDP per employed person would over estimate costs. The International Labour Organisation had missing employment data for several countries. To fill in these gaps we took an average for the labour force participation rate and calculated the average proportion of the population that are employed.

Deaths due to injury

To calculate the impact of deaths due to injury, we estimated the number of employed people that were killed and multiplied it by the expected GDP that they would have made that year. The number of employed that died was calculated by multiplying the number of deaths by the labour force participation rate. Expected GDP loss was obtained by dividing the total GDP in 2016 by the number of people in the labour force. The cost to the economy came to US\$23.5 billion.

Lost days of work due to injury

The cost of working people obtaining an injury and not being able to work was calculated by multiplying the number of employed people injured by the estimate of GDP per working day and the number of days lost from injury, an estimate obtained from the literature. We estimated the number of employed people injured by multiplying the incidence figure for 2016 by the labour force participation rate. This figure was multiplied by GDP per employed person per working day to calculate the cost from losing one day of work due to an injury. For total costs, the figure was multiplied by 15 days, an average we calculated given the estimates from the literature. The cost came to US\$156.7 billion.

Methodology for calculating the incidence of musculoskeletal injury in 2016 in Cameroon, Ethiopia, Ghana and India

We adapted the method used by Dewan et al²⁰ to estimate the annual incidence of musculoskeletal injury for Cameroon, Ethiopia, Ghana and India. Dewan et al originally developed the methodology to estimate the incidence of traumatic brain injury.

The method begins by collecting data on road traffic injuries (RTIs); data on RTIs is relatively reliable compared to other injury data. We took the total number of RTIs in 2016 (latest available data) from the Global Burden of Disease¹ for each country. We then obtained estimates of the proportion of patients

(c) <https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups>

(d) <https://www.ilo.org/global/lang-en/index.htm>

(e) <http://data.eiu.com/>

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who sustained a MSK injury from RTIs for each country from the literature (see the “justifications” row in Table 1). Multiplying the total number of RTIs by this proportion gave us an estimate of the total number of RTIs that resulted in MSK injury.

As there are many other causes to MSK injury other than RTIs, we also retrieved from the literature estimates of the proportion of MSK injuries that are caused by RTIs in each country. By dividing the number of RTIs resulting in MSK injury by the proportion of MSK injuries caused by RTIs, we obtained an estimate of the total number of MSK injuries in each of the countries.

Finally, to calculate the incidence rate of MSK injuries from all causes, we took the total number of MSK injuries and divided it by the population in 2016, obtained from the Economist Intelligence Unit data tool.^(f) Incidence is expressed as annual incidence of MSK injuries from all causes per 100,000 people.

There are a number of limitations to this methodology. First, incidence estimates for the total number of RTIs from the GBD database are themselves approximate estimates calculated from incomplete data. Second, we relied on the best available literature for estimates of the proportion of MSK injuries caused by RTIs, and proportion of patients who sustained a MSK injury from RTIs. However, this literature is often incomplete, prone to bias and can contain uncertainties. We describe the rationale and limitations of each source in Table 3. The definitions that we used for MSK injuries varied in the literature, Table 2 sets out the number of papers reviewed and the definitions of for MSK injury for the papers we selected. We also describe below the literature review and extraction process.

Literature Search

We reviewed 30 papers in order to obtain estimates for the proportion of RTIs resulting in MSK injury and the proportion of MSK injuries that are caused by RTIs. The reviewed papers exhibited high heterogeneity, in that they measured a variety of MSK injury types in a range of settings. We therefore decided not to take a weighted average for any of the countries. Instead, we ranked which paper we thought provided us with the best estimate by critically appraising the variables they measured, time frame and methodology.

From the 11 papers identified for India, 3 papers estimated RTIs resulting in MSK injury. The proportion we chose to use came from Gururaj 2016 (58%).⁵¹ This estimate was at the top end of the range (the range of estimates spanned from 21%-58%), however not all of the papers measured all injuries from RTIs. We found 8 papers that measured the proportion of MSK injuries that are caused by RTIs. We decided to go with the estimate from Foote 2015 (51.8%)⁷⁰ which gave us a view of the wider picture compared to the other papers; they looked more specifically at a region, age group or type of injury.

From the 7 papers found for Ethiopia, only 2 calculated the proportions of RTIs resulting in MSK injury. We chose the estimate that came from Azaj 2013 as the second paper only recorded incidents from patients admitted to the Emergency Department.⁷¹ For the proportion MSK injuries that resulted in RTIs, we decided to use the estimate from Misker 2017, which fell between the range from the 5 papers identified. (30.3%-62.5%).⁷²

Ghana and Cameroon each had 6 papers written around the subject. With only two estimates to choose from for the proportion of RTIs resulting in MSK injury, we opted for Kudebong 2011⁷³ for Ghana as the alternative paper excluded those aged over 15. For the proportion of MSK injuries that are

(f) <http://data.eiu.com/>

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caused by RTIs we identified 4 papers from our literature search. We decided to use the estimates from Torbenu 2017⁷⁴ as the other papers looked more specifically at certain types of injuries caused by RTIs rather than all MSK injuries.

For Cameroon, we chose to use the data from Chichom-Mefire 2018²² as the other paper was conducted over a shorter time period and only looked at motorcycle injuries. For the second proportion, we opted for the estimate from Juillard 2014²³ as the proportion of MSK injuries caused by RTIs fell in the range from the identified papers which spanned between 36%-70%.

Table 2: Total number of papers identified for each country and the definition for the estimate used

	Proportion of RTIs resulting in musculoskeletal injury		Proportion of musculoskeletal injuries that are caused by RTIs		Total
	Papers identified	Definition from literature for estimate used	Papers identified	Definition from literature for estimate used	
India	3	% of victims that sustained injuries to their head, upper and / or lower limbs	8	Fractures and dislocations ⁷⁰	11
Ethiopia	2	% of unintentional injuries caused by motor vehicle incidents	5	Magnitude of trauma caused by road traffic accidents	7
Ghana	2	Fractures of the humerus, femur etc. ⁷³	4	Fractures, arthritis, dislocation, back pain, ligament, amputation and tendon injuries ⁷⁴	6
Cameroon	2	Single long bone fractures in road traffic victims ²²	4	Injuries caused by RTIs for patients who visited the emergency department ²³	6

Calculations and Results

Table 3: Estimates of the annual incidence of musculoskeletal injuries per 100,000 people in India, Ethiopia, Ghana and Cameroon

	India	Ethiopia	Ghana	Cameroon
Total number of RTIs in 2016	12,656,103	559,696	157,521	121,060
Proportion of RTIs resulting in MSK injury	58%	30.3%	28.6%	34.52%
Number of RTIs resulting in MSK injury	7,340,540	169,588	45,051	41,790
Proportion of MSK injuries caused by RTIs	51.8%	47%	42%	59%
Total MSK injuries (from all causes)	14,170,926	360,825	107,264	70,831
Population (2016 estimate)	1,324,172,000	102,400,000	28,210,000	23,440,000
Annual incidence of MSK injuries from all causes per 100,000 people	1,070	352	380	302

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Table 3: Estimates of the annual incidence of musculoskeletal injuries per 100,000 people in India, Ethiopia, Ghana and Cameroon (continued)

	India	Ethiopia	Ghana	Cameroon
Justifications	<p>Gururaj 2016⁵¹ <u>Rational</u> Records were taken for a full year for all incidents for people aged 15-60. Incidents were recorded for several types of RTIs <u>Limitations</u> The study was based in a large rural district - the figures may not exactly be proportional for urban areas</p>	<p>Azaj 2013⁷¹ <u>Rational</u> Systematic review of 36 articles looking at the epidemiology of injuries in Ethiopia <u>Limitations</u> The study isn't specific to RTIs, it takes a weighted average of studies</p> <p>Misker 2017⁷² <u>Rational</u> Recent cross sectional interviews were conducted <u>Limitations</u> Only one month's data is available and all the interviewees are from the same hospital</p>	<p>Kudebong 2011⁷³ <u>Rational</u> Two articles were found for Ghana, and the other one only looked at under 15 year olds <u>Limitations</u> <ul style="list-style-type: none"> • Only looks at motorcycle RTIs but in this particular municipality but 98% of vehicles registered between 2004-2008 were motorcycles • Short time frame: data from one month • Data is only from one municipality <p>Torgbenu 2017⁷⁴ <u>Rational</u> Data is from a six month period and looks at all injuries caused by vehicular crashes <u>Limitations</u> <ul style="list-style-type: none"> • The patients selected were being treated in a specialist orthopaedic hospital so the proportion could be overestimated • Looks at the number of incidents in one town only </p> </p>	<p>Chichom - Mefire 2018²² <u>Rational</u> Data was collected over a 5 month period where over 800 cases were included <u>Limitations</u> <ul style="list-style-type: none"> • only report long bone fractures and not all MSK injuries • data is only collected from one hospital <p>Juillard 2014²³ <u>Rational</u> More of an urban hospital so figures may be more representative of the wider population figures <u>Limitations</u> Data only accounts for patients who went to the emergency department</p> </p>
		<p>Foote 2015⁷⁰ <u>Rational</u> Multicentre, observational study of patients who presented to 14 hospitals across India for MSK trauma <u>Limitations</u> Preliminary paper</p>		

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