

Strengthening the prevention and care of injuries worldwide

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The global burden of injuries is enormous, but has often been overlooked in attempts to improve health. We review measures that would strengthen existing efforts to prevent and treat injuries worldwide. Scientifically-based efforts to understand risk factors for the occurrence of injury are needed and they must be translated into prevention programmes that are well designed and assessed. Areas for potential intervention include environmental modification, improved engineering features of motor vehicle and other products, and promotion of safe behaviours through social marketing, legislation, and law enforcement. Treatment efforts need to better define the most high-yield services and to promote these in the form of essential health services. To achieve these changes, there is a need to strengthen the capacity of national institutions to do research on injury control; to design and implement countermeasures that address injury risk factors and deficiencies in injury treatment; and to assess the effectiveness of such countermeasures. Although much work remains to be done in high-income countries, even greater attention is needed in less-developed countries, where injury rates are higher, few injury control activities have been undertaken, and where most of the world's population lives. In almost all areas, injury rates are especially high in the most vulnerable sections of the community, including those of low socioeconomic status. Injury control activities should, therefore, be undertaken in a context of attention to human rights and other broad social issues.

Introduction

Injury is one of the leading causes of death in children and working-aged adults in almost every country. There are more than five million injury-related deaths every year, as well as a tremendous burden of disability and economic loss;¹⁻⁴ yet, little attention is given to injury. In high-income countries, research expenditures for injury are small compared with those for cancer and cardiovascular disease.⁵ The situation is even more pronounced in less-developed countries. External assistance to the health sector of less-developed countries was US\$2-3 per disability adjusted life year (DALY) lost to major infectious diseases such as HIV/AIDS and malaria, but only \$0.06 per DALY lost to injury.⁶

Part of this neglect might stem from the fact that the solutions lie outside the usual frameworks of health care. Part may also stem from a sense of fatalism, that injuries are caused by bad luck and that little can be done to prevent them. However, the experience of most high-income countries over the past 40-50 years has been that, in fact, injury rates can be lowered and the consequent morbidity and mortality can be reduced.^{5,7,8} Part of the success has been achieved through advances in transport systems, housing construction, and industrial machinery. However, much has been accomplished by the application of scientific methods of injury prevention and control.⁷⁻⁹

The largest gains are to be made in less-developed countries, where rates of injury-related death are highest^{1,10} (table and figure), where there have been limited applications of scientific methods of injury control, and where most of the world's people live. Improvements are needed across a range of injury control activities, encompassing surveillance, prevention, and treatment. For all of these, progress can be made by applying or adapting some of the interventions that have been effective in high-income countries. However, there is an important role for new research to identify and elucidate injury risk factors and to rigorously assess the effectiveness of injury control policies in less-developed countries.¹¹⁻¹⁴

In this review, we discuss what is known and what new information is needed. This includes both basic research to elucidate injury risk factors and operations research to decide how best to implement and assess policies to promote safety in different societies worldwide. The major focus of this review is to identify ways in which current injury prevention and treatment could be strengthened, especially in less-developed countries.

Search strategy

Studies selected for this review were identified from MEDLINE. We also used articles from the grey literature and journals from Mexico, Malaysia, and Ghana that are not MEDLINE referenced. These included unpublished documents, institutional and government reports, and conference proceedings. We considered any article addressing the subject of injury in any country. Studies were included or excluded on the basis of their contribution to the principal question of how the current scenario of injury control could be strengthened, for both research and policy. We also drew from our own expertise and experiences with the prevention and treatment of injuries in several countries at different economic levels.

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	High-income countries	Low-income and middle-income countries
Road traffic injury	13.6	22.1
Poisoning	2.2	5.8
Falls	8.3	4.0
Fires*	1.0	4.5
Drowning	1.7	8.4
Other unintentional injuries†	8.3	15.2
Self-inflicted injuries	13.3	13.5
Violence	2.8	9.6
War	0.02	6.0
All injury-related deaths	51.2	89.1

Rates are per 100 000 per year. *Fire-related burns only (ie, flame burns and respiratory damage due to smoke inhalation). †Includes injuries resulting from animate and inanimate mechanical forces (including firearms); electric current; radiation; extreme ambient temperature and pressure; forces of nature; contact with heat and hot substances; and venomous plants and animals. Data from WHO.¹³⁷

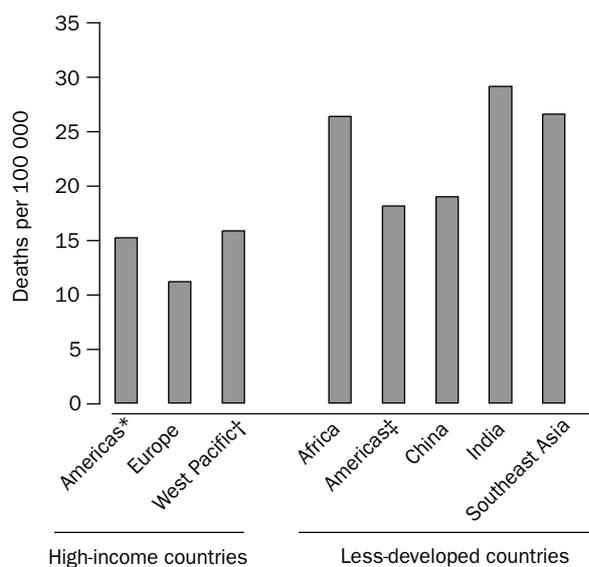
Rate of injury-related deaths by mechanism of injury and economic status

Surveillance

All too often, injury control activities in both high-income nations and less-developed countries have been done without adequate assessment of their effectiveness.^{9,15} Data on the extent and characteristics of injuries should be collected in every country. Such follow-up assessment would allow better targeting of interventions and assessment of their success or failure. Most high-income countries have formal surveillance systems, such as the Fatality Analysis Reporting System (FARS)¹⁶ for road-traffic deaths in the USA.

Few less-developed countries have formal injury surveillance systems. Most do have some system to gather information on injuries, which usually relies on police reports and vital statistics. Several factors diminish the usefulness of such data, including it not being freely available; delays in compilation; questionable reliability; and under-reporting. For example, in Ghana, studies showed that fewer than 10% of pedestrian injuries were reported to the police and only 10% of injury deaths were accurately recorded by vital registries.^{17,18}

Surveillance systems in less-developed countries could be improved substantially with small expenditure. An



Deaths from road-traffic injuries by economic group in selected regions of the world, 2000

Data from Peden et al.¹³⁸ *USA, Canada, and the Bahamas. †Australia, New Zealand, Brunei, Japan, Republic of Korea, and Singapore. ‡South America, Central America, and Caribbean countries.

upgrade of pre-existing systems such as police reports, hospital discharge data, and vital registries might be more feasible than creating entirely new data collection mechanisms.¹⁸⁻²¹ An example is South Africa's National Non-Natural Mortality Surveillance System, which gathers data from selected mortuaries nationwide.²²

Hence, questions that need to be addressed include: what feasible, minimum standards can be created for injury surveillance that are universally applicable? How can existing information systems be upgraded to provide better data on injury? What policies can be instituted to remove political barriers to linkage, access, and use of existing data?

WHO has made progress in promoting surveillance by publishing guidelines for collecting, coding, and processing injury data. These were developed to be universally applicable, but especially useful for circumstances in which there are no electronic equipment, staff with other time demands, and limited expertise in injury data.^{23,24}

Injury prevention

The field of injury prevention encompasses both unintentional injuries (including safety on the road and on other transport, in the home, the workplace, and during recreation) and intentional injuries (ie, violence and suicide). Many specific interventions have proven successful in reducing injuries in high-income countries. For road safety, these interventions include roadway engineering techniques, such as breakaway lighting poles and controlled intersections; vehicle modifications, such as collapsible steering columns and side-impact protection; and alteration of human behaviour, such as seatbelt use and speed control. Other successful interventions include smoke detectors, regulation of water-heater temperature, flame-resistant clothing, and window bars to prevent falls.^{7-9,25}

Obviously, much more needs to be done in high-income countries by both investigating new interventions and fully implementing ones known to be effective. For example, pedestrian injuries can best be approached through environmental modifications. However, work is needed to decide which devices are most effective for traffic calming and decreasing the risk of pedestrian injuries.²⁶ Research is especially needed on ways to decrease intentional injuries. In the USA, the potential effect on murder and suicide from restrictions on gun availability are a source of much debate because the data are unclear and are not based on large intervention trials. The most promising interventions to decrease violence seem to be those implemented in the first few years of life, such as nurse home visits and preschool of high quality, but the effect of these if widely implemented is unknown.^{27,28}

Much also remains to be done to more fully implement proven interventions that have been hindered by political opposition. These include universal motorcycle-helmet laws, seatbelt laws, and random alcohol-breath-testing roadblocks.^{9,29,30}

In this review, we focus on road traffic injuries, the leading cause of injury-related death in both high-income and less-developed countries, and one of the mechanisms of injury with the best track record for prevention.

Road traffic injuries

Much of injury prevention is based on the theoretical foundation of Haddon's matrix, in which host, vector, and environmental factors interact before, during, and after the injury. This model is especially evident in the interacting components of road safety: roadway

infrastructure (environment), vehicle (vector), and human behaviour (host). A scientifically-based, organised approach to each of these can lower the death toll from road traffic.^{9,31,32}

Infrastructure—various features affect road safety, including curvature, intersection design, signage, and shoulders.³³ Infrastructure has a key role in addressing one of the largest injury prevention priorities—pedestrian injuries.^{10,18,34–36} Specific pedestrian safety issues include separation of pedestrian and vehicle flows, safe crossings, and traffic-calming measures to decrease vehicle speeds in urban areas.^{33,37,38} A major policy priority is to increase use of known safety-related engineering features. Such features include new construction and renovations based on identification of dangerous sections of roadway through timely feedback from crash statistics.³⁹

However, most current traffic engineering practices are based on evidence from high-income countries. In these countries, there is usually a homogeneous mix of motorised vehicles. In many less-developed countries, in addition to motor vehicles, there are many vulnerable, non-motorised road users such as pedestrians and bicyclists, who need to be taken into account in traffic safety policy.^{10,15,40}

Vehicles—factors include those that decrease the likelihood that vehicles will become involved in crashes (crash avoidance) and those that decrease the likelihood that injury will occur in the event of a crash (crashworthiness). Many advances have come about through legally mandated motor-vehicle safety standards in high-income countries.^{29,41–45} The status of standards for vehicles manufactured in less-developed countries is not well known and is almost certainly less stringent than that in high-income countries.¹⁵ International adoption of safety standards for motor vehicle manufacture could result in safer vehicles worldwide, without necessarily increasing their cost.

Safety standards for front-end construction to make vehicles less hazardous to pedestrians may be as important as standards that affect vehicle occupants. Political obstacles have made such standards difficult to implement.^{15,46,47}

Vehicle maintenance also needs consideration, especially in low-income countries that import used vehicles. For example, commercial drivers in Ghana reported using a soap and water mixture in their brake tubing because of the high cost of hydraulic brake fluid. The relation between such low maintenance and crashes is not well known, but could be important.^{48–50} A policy issue worth addressing is the cost and availability of safety-related spare parts such as tyres, brake components, and headlights. For example, would it be cost effective for countries to reduce import taxes on these materials?

Driver behaviour—two areas where safety gains could be made are speed control and alcohol. Vehicle speed is a important determinant of injury risk, for both vehicle occupants and pedestrians.⁵¹ Two studies from less-developed countries showed that speed is one of the more readily controllable factors affecting the incidence and severity of pedestrian injury.^{52,53} For example, a study of sites of pedestrian injury in Ghana showed that almost half (47%) of all passing vehicles were exceeding the speed limit. Lack of speed control is probably also a main factor in the severity of crashes on interurban roads. Most African countries have neither posted nor enforced speed limits on such roads.⁵²

Speed control will involve law enforcement, behaviour change, and traffic-calming infrastructure, and is an initiative that should be taken further in most less-developed countries.^{37,53}

Efforts to combat drink driving have been a cornerstone of road safety efforts in high-income countries. Preliminary evidence suggests that alcohol-impaired driving is also an important risk factor that should be targeted in most less-developed countries. In a review of 26 articles on road traffic injuries in developing countries, Otero and colleagues⁵⁴ report that 30–50% of drivers involved in road accidents were intoxicated.^{54–57}

Governments should assess the extent of drink driving in their own countries, with efforts that might include testing for blood alcohol in fatally injured drivers and random roadside alcohol-breath-testing surveys. If high rates of drink driving are confirmed, increased legislative, law enforcement, and educational activities against it would be warranted. Various interventions have proven effective, mostly in high-income countries, including random alcohol-breath-testing roadblocks, administrative license revocation, and scientifically-based social marketing.^{25,58,59} Investigators should assess which techniques would be most effective in different social contexts worldwide.

There are many other safety-related behaviours to address. What policies should be instituted to promote use of proven safety measures—such as seatbelts and helmets—in environments where they would make a difference? For example, how could helmet use be encouraged in Asia, where motorcycles are a common form of transport?^{60–62} Helmets that are effective, yet cool enough for tropical climates need further assessment. Ways to promote effective legislation and enforcement need to be sought. For example, the Indonesian mandatory motorcycle helmet law does not specify a standard. Any type of hat may be worn as a helmet.^{63,64}

Broader road safety considerations—we have focused on specific, technical issues of road safety; however, our points are best viewed in a broader context. Environmental issues consist of more than roadways alone and include patterns of land use and urban development. Large sprawling cities have promoted car dependence. Such dependence has been supported by some governments, who enact policies that promote road infrastructure and cheap fuel. Compact urban planning and initiatives to increase public transport use may reduce the use of private cars.⁶⁵ Another consideration is the working conditions of commercial drivers, who are the backbone of transportation systems in many less-developed countries. They often work long hours just to pay the daily rent on their vehicles, before they can even begin generating a profit. Such socioeconomic constraints cause drivers to work while exhausted and to ignore speed limits and other safety regulations.^{48,66} Broad factors must be considered by people working on road safety, irrespective of the country.

Other unintentional injuries

Frequent causes of death worldwide, especially in children, include drowning, burns, and falls.⁴ Proven interventions exist to decrease the incidence of all of these, with almost all of the evidence coming from high-income countries. For drowning prevention, interventions include promotion of life vests on boats and swimming pool fencing, which has been associated with a 73% decrease in the risk of drowning to children younger than 6 years.^{7,8,25,67,68} For burn prevention, these include lowering of water heater temperature to 50°C or less, flame

resistant sleepwear for children, and smoke detectors, which have brought about a 61% reduction in the risk of death in a residential fire.^{7,8,25,69-71} Window guards on high rise buildings have resulted in 50% reduction in falls.⁷²

However, few of these interventions are readily transferable to less-developed countries. Childhood drowning in many less-developed countries occurs in wells, cisterns, irrigation ditches, and rice-paddy fields.^{2,73-76} Childhood burns result from various factors such as knocking over ground-level cooking pots being heated on open wood fires or small kerosene stoves.⁷⁷⁻⁷⁹

Priorities for prevention of drowning and burns should involve better understanding of the basic epidemiology and risk factors for these injuries in less-developed countries. Well-evaluated pilot programmes to test prevention strategies are desperately needed.

Intentional injuries

After road-traffic accidents, the next largest burden of injury-related deaths in both high-income countries and less-developed countries is from self-inflicted injuries and interpersonal violence. Various prevention interventions have been implemented;^{25,80-88} however, little work has been done to measure how well they work. The sporadic nature of suicide and violence necessitates large sample sizes to assess effectiveness. Furthermore, the under-reporting of suicides severely hampers research.

Worldwide, more scientifically-based research is needed to better understand the complex interplay of psychological, societal, and environmental factors that affect the likelihood that someone will try to harm themselves or others.⁸⁹⁻⁹¹ Interventions should be subject to rigorous evaluation. For example, one study by Holt and colleagues⁹² on intimate-partner violence showed that year-long restraining orders were more likely to lead to a decrease in subsequent acts of violence against women than were short-term orders.⁹²

Historically, injury-prevention efforts have concentrated on unintentional injuries. Suicides have been seen as an issue for mental-health workers, and violence as the domain of the criminal justice system. The medical and public-health community should engage in efforts to confront intentional injuries. Such initiative are supported by the WHO *World Report on Violence and Health*, which has emphasised the role that public health can have in violence prevention.⁹³ This report points out the important role that public-health agencies have through their focus on changing the behavioural, social, and environmental factors that give rise to violence. Public-health programmes also bring a focus on prevention, a scientific outlook, and the potential to coordinate multidisciplinary approaches.

Injury treatment

Prehospital care

Most injury-related deaths occur before any chance of treatment, indicating the importance of prevention in all countries. The proportion of prehospital deaths seems to increase with decreasing economic status. For example, 81% of injury deaths occurred in the field in Kumasi, Ghana compared with 59% in Seattle, USA.⁹⁴ Based on the site of death of most injury victims, development of prehospital emergency medical services (EMS) could be more effective in reducing death rates than would hospital-based improvements.

Findings from several middle-income countries with existing emergency medical services show that sustainable, low-cost improvements in training, equipment, and infrastructure can decrease deaths.⁹⁵⁻⁹⁷ A study in Mexico⁹⁷ showed that death rates in transported trauma patients

dropped (from 8.2 to 4.7%) after increases were made in the number of ambulance dispatch sites and the institution of regular continuing education on trauma care for ambulance attendants. In Brazil,⁹⁸ institution of a new emergency medical service along a highway where none had previously existed decreased the case-fatality rate of people involved in road accidents.

The situation in low-income countries differs from that in high or middle-income countries. Resource restrictions and limited telecommunications would mean that formal emergency medical services (like those in high-income countries) may not be cost-effective.⁹⁹ Instead, building on existing, albeit informal, systems of prehospital transport might be a reasonable alternative. For example, in Ghana most injured people who make it to a hospital are transported by taxis and minibuses.¹⁰⁰ A pilot programme providing basic first-aid training to commercial drivers increased the provision of first aid at the site of the injury.¹⁰¹ Likewise, in mine-infested areas of Kurdistan and Cambodia, one programme created a two-tiered response system. The first tier included lay first responders, with first-aid training. The second tier was made up of a small number of paramedics with more advanced training. Equipment and supplies were provided, but ambulances were not. Injured people continued to rely on the existing system of private and commercial vehicles, as well as non-motorised transport. Death rates in severely injured people decreased from 40% to 9%.¹⁰²

Irrespective of the context of prehospital care, better evidence on the effectiveness of interventions is needed. Cochrane Collaboration reviews noted a dearth of evidence on many prehospital injury care interventions, including administration of intravenous fluids, advanced life-support training, and routine spinal immobilisation.¹⁰³⁻¹⁰⁵ Rigorous assessment of the effectiveness of prehospital interventions is needed and should be a research priority.

Hospital-based care

Hospital-based changes in care are likely to have a positive effect on death rates. Low-cost improvements in training have lowered the rate of injury-related deaths in middle-income countries. For example, Ali and colleagues^{106,107} assessed the effectiveness of regular implementation of a 2-day continuing education course on trauma care (the Advanced Trauma Life Support Course [ATLS]) at the main hospital in Trinidad. After most doctors caring for injured patients at that hospital had been ATLS certified, death rates in severely injured patients decreased from 67% to 34%.¹⁰⁶⁻¹⁰⁸

Moreover, hospital-based care is likely to reduce disability, especially in less-developed countries where the injury-related disability is mainly related to arm and leg injuries.¹⁰⁹ Disability from such injuries should be readily amenable to low-cost improvements in orthopaedic care and rehabilitation.

Hospital-based improvements can be made in several areas: human resources (training and staffing); physical resources (equipment and supplies); administration; and access to care. Studies in Ghana show some of the deficiencies that need attention.

Hospitals in rural areas along major roads receive large numbers of casualties, yet are usually staffed by general practitioners and nurses with no specific training in injury care.^{110,111} Of 11 rural hospitals along major roads in one study, none had chest tubes and only four had emergency airway equipment. Poor organisation and planning, rather than resource restrictions, were the main reason for the absence of such vital equipment.¹¹²

Even at an urban teaching hospital, there were substantial problems with the process of injury care. There was a mean of 12 h between presentation and emergency surgery. Chest tubes were rarely used, even though they were available. London and colleagues¹¹³ identified quality improvement programmes (medical audit) as a possible means to address many of the problems.

A household survey revealed that 68% of injured people in cities and only 51% in rural areas received formal medical care. The most frequent reason for not receiving such care was financial, which is related to the upfront user fees that are imposed in Ghana as part of cost recovery schemes.¹¹⁴ This finding lent support to calls for suspension or postponement in collection of charges in emergency situations. Similar difficulties are reported by many other less-developed countries.^{115–119}

Foundations for improved injury care

Trauma system organisation

Efforts to strengthen injury treatment worldwide can build on trauma system organisation in place in several high-income countries. Part of such organisation entails trauma service verification, involving a review of hospitals' completeness for clinical services (human resources), physical resources, and administrative functions, such as quality improvement. Such verification is provided by professional organisations,¹²⁰ while governments designate which hospitals should fill the roles of trauma centres at varying levels of complexity, ranging from large urban centres to small rural hospitals. Trauma system organisation also implies planning for emergency medical services, prehospital triage, transfer criteria, and transfer arrangements between hospitals.

Reorganisation of trauma systems can result in lowered rates of death in patients with injuries—for example, researchers have noted decreases of 15–20% in overall death rates and a halving of medically preventable deaths in medical systems with well organised trauma systems.^{121–124}

Essential health services

Efforts to strengthen injury treatment can also build on essential health service, such services are those that are low-cost and high-yield and that could realistically be made available to almost everyone in a population. Examples include: the Essential Drugs Programme,^{125,126} the Expanded Programme on Immunizations, the Global TB Program,¹²⁷ and the Safe Motherhood Initiative,^{128,129} A similar approach has not yet been implemented for injury care.

Essential trauma care

Improvements in injury treatment could probably be brought about through better organisation along the lines of trauma system planning. WHO and the International Society of Surgery have a project underway to elucidate what treatment capabilities should be available in hospitals of varying levels in countries at varying economic levels. The collaborative Essential Trauma Care Working Group has developed a list of injury treatment services that are deemed essential and/or desirable in different settings. This group has developed a model template for the human resources, physical resources, and administrative mechanisms needed to assure such services. The template is intended to assist individual countries in developing their own trauma system plans.¹³⁰ As there are few data on the effectiveness of such trauma system organisation in less-developed countries, assessment will be an essential component of any such efforts.

Capacity for injury control

All the efforts for surveillance, prevention, and treatment of injuries that we have discussed require a certain level of resources and legal authority within institutions such as universities, road safety agencies, and ministries of health. Because road traffic is such a great cause of injury, the role of road safety agencies merits special attention. In most countries, there is a need for a sufficiently funded government department, with adequate and appropriately trained staff, and with legal authority to gather needed information and to enact and assess road safety policy.¹⁵ An important policy consideration is how to institutionalise such funding and legal authority in different countries worldwide. All of this is, of course, predicated on being able to position injury control sufficiently high on governmental agendas.

The safety situation in most less-developed countries is very different from that in high-income countries. Hence, injury control strategies that have been applied in high-income countries can rarely be automatically applied to less-developed countries. Some strategies will need to be adapted for less-developed countries, others will have to be rethought altogether. Such work will require expertise in several categories. For example, epidemiologists who can handle injury data, engineers who can deal with safety-related features of roads, and vehicle and other product design; police, lawyers, and others involved in legislation who can assess traffic and other laws from a safety and health perspective.¹³¹ Further, public-health workers and media experts with a background in safety-related behaviour change; behavioural scientists who can elucidate risk factors for suicide and violence and who can develop appropriate prevention strategies; and clinicians who can understand the public-health viewpoint and develop cost-effective improvements in the entire trauma treatment system.

Although people from all of these backgrounds are involved in injury control in most countries, the number of workers is too few. A major policy implication is how to expand the existing expertise and how to encourage collaboration between disciplines.

Furthermore, political realities prevent implementation of safety measures that are effective and seem reasonable to those concerned with public welfare.^{29,132} In some cases, there is resistance to behaviour change on the part of a segment of society, such as motorcyclists opposing mandatory helmet use. In other cases, safety measures have been blocked by interests that stand to lose financially. For example, in the USA opposition to motor-vehicle safety standards by automotive manufacturers and resistance to gun control policies by the National Rifle Association and its allies in the gun manufacturing industry have been factors limiting injury control.^{29,133}

Finally, injury, as with many diseases, must be viewed in the context of broader social issues, some of which have been alluded to in the section on injuries from road-traffic accidents. Important issues are the violation of the rights of workers to a safe workplace, the international trade in arms and landmines, continued use of torture, and state-sponsored terrorism, war, and genocide. Although beyond the scope of this review, these are all factors that contribute to injury death rates globally, especially among the poor and disadvantaged.⁹³ In all countries, the lower socioeconomic strata are most at risk for injury.^{10,66,134–136} These are the people with the least power and resources to improve an unsafe environment, even when the risks are known.

Such challenges will require all those who work in injury control, from every profession and in every location, to develop skills in advocacy and politics and be willing to take on difficult issues of equity and human rights.

Research and policy development issues to strengthen the prevention and treatment of injuries worldwide

Surveillance

- What minimum standards can be promoted for useful and realistic injury surveillance for all countries?

Road safety

Infrastructure/road engineering

- What design features are most effective in different traffic environments worldwide, especially in less-developed countries with mixes of motorised and non-motorised transport?
- What policies can institutionalise use of known safety-related engineering features?

Vehicle engineering and maintenance

- Which vehicle safety-design features are most critical to reducing crash injury? Given the high incidence of pedestrian injuries worldwide, what features of front-end construction can be devised to make them less hazardous?
- Which features of vehicle maintenance are associated with road-traffic crashes?
- Which policies can be implemented to promote safety manufacturing and maintenance standards worldwide?

Driver behaviour

- Which techniques of social marketing, law enforcement, and engineering are most effective in improving speed control and decreasing alcohol-impaired driving in societies around the world?
- Which policies need to be instituted to promote use of proven safety technologies in environments where they would make a difference, such as helmets in countries where motorcycle use is common?

Other unintentional injury

- What is the basic epidemiology and which are the risk factors for the most prevalent unintentional injuries, including drowning, burns, and falls?
- Which interventions can be developed and piloted to address these risk factors in different societies?

Intentional injury

- Of the complex interplay of environmental and psychological factors that affect whether someone will seek to harm themselves or others, which factors are amenable to intervention?
- Which suicide and violence-prevention interventions are effective in different societies worldwide?

Injury treatment

- Which prehospital injury treatment methods are effective and feasible?
- Which hospital-based treatment methods can be considered "essential" for reduction of both mortality and disability?
- Which policies are needed to promote known essential trauma services in different countries worldwide?

Capacity building

- What funding, legal authority, and which expertise are needed by institutions in different countries to adequately complete the work of injury control?

The way forward

Much can be done to lower the huge global burden of death and disability from injury by improved application of scientifically-based evidence on injury control, and strengthened surveillance, prevention, and treatment. Current efforts, especially those in less-developed countries, could be enhanced by addressing various research and policy issues (panel), but more human resources, finances, and legal authority are needed. Furthermore, injury-control workers need to be versed in advocacy and politics and should take on difficult issues of equity and human rights.

Contributors

C Mock wrote the first draft and revision. All authors participated in the concept design, literature search, and reviewed the paper for critical content.

Conflict of interest statement

None declared.

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