

# Addressing the Growing Burden of Trauma and Injury in Low- and Middle-Income Countries

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Low- and middle-income countries suffer disproportionately from reduced life expectancy and quality of life. Injuries are overlooked as contributors to global inequities in health, yet the long-term disabilities they frequently produce represent a significant burden.

The Fogarty International Center of the National Institutes of Health convened a panel of experts in trauma and injury from the United States and low- and middle-income nations to identify research gaps in this area and opportunities to create new knowledge. Panel members identified sustainable programs of research established through stable linkages between institutions in high-income nations and those in low- and middle-income nations as a priority.

The resulting benefits of addressing the growing burden of trauma and injury to communities in resource-constrained settings around the world would be substantial. (*Am J Public Health*. 2005;95:13–17. doi: 10.2105/AJPH.2004.039354)

**SIGNIFICANT DISPARITIES IN** life expectancy and quality of life exist between high-income countries, where 15% of the world's population resides, and low- and middle-income countries, where the remaining 85% of the global population resides. Three quarters of individuals residing in low- and middle-income countries die before the age of 70 years, as compared with 40% of the residents of high-income countries.<sup>1</sup>

With the exception of road traffic injuries, the effects of trauma and injuries on premature mortality and long-term disability are often overlooked in part because of the well-recognized burden of infectious diseases and malnutrition, which account for 16 million deaths per year. However, each year intentional and unintentional injuries account for nearly 1 in 10 deaths worldwide,<sup>2</sup> with mortality rates differing according to countries' socioeconomic characteristics. For example, the mortality burden from all types of injuries in high-income countries is 10% of that in low/middle-income countries. Similar patterns and percentages can be observed with respect to disability-adjusted life-years (Table 1).<sup>3</sup> In both high-income and low/middle-income countries, unintentional injuries constitute 68% of total mortality resulting from injury, including road traffic injuries, drownings, poisonings, burns, and falls (Table 1).<sup>3</sup>

Road traffic injuries account for roughly one quarter of the total number of injury deaths

worldwide. Ninety percent of this burden is borne by low/middle-income countries,<sup>2</sup> where such injuries are among the leading causes of death and disability in the 5- to 44-year age group.<sup>4</sup> Moreover, significant gender disparities exist; among males in the 15- to 44-year age group, for example, road traffic injuries are the leading cause of trauma-related death worldwide, whereas suicide is the leading cause among females.<sup>3</sup>

While tremendous resources are consumed caring for injured patients at hospitals in low/middle-income countries, less attention is directed toward gaining a better understanding of injury prevention or initiating organized efforts to improve trauma treatment systems. Knowledge dissemination regarding patterns of injuries, demographic characteristics, and areas where injuries occur would assist in determining how such care can be improved and would most likely have an impact on disability as well as mortality rates.<sup>5,6</sup> For example, in low/middle-income countries, long-term disability following extremity injuries is more widespread in rural areas than in urban areas, where morbidity and mortality caused from head and spinal cord injuries predominate.<sup>6,7</sup> Without more evidence and more cost-effectiveness data, the level of funding devoted to trauma and injury programs will remain comparatively low.<sup>8</sup>

Our goal is to provide an understanding of the contribution of trauma and injury to the

global burden of disease. In addition, we illustrate why research is essential, identify priorities for such research, and discuss some of the challenges posed in conducting research in low/middle-income countries.

## BACKGROUND

According to estimates from the World Health Organization (WHO), almost 90% of deaths due to injuries occur in low/middle-income countries, and this situation will continue to represent an important global health problem in the upcoming years.<sup>9,10</sup> The newly independent states in Europe, which fall mainly into the middle-income category, exhibit the highest overall injury mortality rates, while North America, Western Europe, and Australia/New Zealand exhibit the lowest rates.<sup>2,11</sup> Among both male and female residents of the low/middle-income countries of the Americas, interpersonal violence is the leading cause of death and disability in the 15- to 44-year age group.<sup>2</sup> However, while figures vary according to region, 1 million people die annually and about 10 million are seriously injured on the world's roads,<sup>10</sup> and the global cost of these accidents is estimated at \$500 billion.<sup>12</sup> In low/middle-income countries, elderly and child pedestrians, cyclists, and riders of 2-wheeled motor vehicles are most at risk of vehicle-related injuries.<sup>2,10,13,14</sup>

Among the many reasons why trauma is so devastating in many low/middle-income countries

**TABLE 1—Global Burden of Injuries in Low-, Middle-, and High-Income Countries: Data From 2001**

	Low/Middle-Income Countries			High-Income Countries		
	Male	Female	Both	Male	Female	Both
<b>Mortality</b>						
Total deaths from all injuries (1000s)	3 170	1 547	4 717	314	157	471
Unintentional injuries (1000s)	2 096	1 120	3 216	202	119	321
% of total injuries	44.44	23.74	68.18	42.89	25.27	68.15
Intentional injuries (1000s)	1 075	427	1 501	112	38	151
% of total injuries	22.79	9.05	31.82	23.78	8.07	32.06
<b>DALYs (from death and disability)</b>						
Total DALYs from all injuries (1000s)	101 779	54 166	155 945	7 692	3 552	11 244
% of total DALYs	7.34	3.90	11.24	5.16	2.38	7.53
Unintentional injuries (1000s)	70 805	42 501	113 306	5 189	2 687	7 876
% of total injuries	45.40	27.25	72.66	46.15	23.90	70.05
Intentional injuries (1000s)	30 975	11 665	42 640	2 503	865	3 368
% of total injuries	19.86	7.48	27.34	22.26	7.60	29.95

Note. DALY = disability-adjusted life-years. Data were derived from the National Institutes of Health (<http://www.fic.nih.gov/dcpp/gbd.html>).

are the inadequate systems of hospital and community-based emergency care in place in these countries.<sup>15–17</sup> Furthermore, often the roads used to transport trauma victims to hospitals are unpaved, few road safety regulations are in place,<sup>16,18–21</sup> and there are inequities between urban and rural areas in regard to access to emergency response systems as well as pre-hospital and hospital emergency services.<sup>9,17,22–29</sup> Inequitable income levels within countries, racial discrimination,<sup>16</sup> and constrained resources<sup>15,17</sup> are compounding problems. In some settings, recognition of the impact of trauma on public health is limited, and thus there is little public education focusing on injury prevention.<sup>5,17,30–32</sup> Another challenge is the lack of trained health care workforces, partly the result of a paucity of specialty training in trauma care.<sup>5,17,33–35</sup>

In response to the global burden of trauma and injury, several agencies have begun to direct resources toward this

serious problem. WHO provides regular estimates on the global magnitude of injuries<sup>2</sup> and recently released 2 landmark reports: *Violence and Health in 2002* and *Road Traffic Injury Prevention in 2004*.<sup>36,37</sup> WHO also is developing guidelines designed for use by individuals providing essential trauma care services and is devising a comprehensive training curriculum for schools of public health focused on preventing injuries and violence.

Complementary efforts are taking place at the US Centers for Disease Control and Prevention (CDC), where funding is targeted to prevention research focusing on trauma and injury. CDC is also developing databases such as the National Violent Death Reporting System.<sup>38</sup> In addition, the independent Task Force on Community Preventive Services, appointed by the director of CDC, publishes a “community guide” that critically reviews prevention interventions; the task force has already covered topics related to intentional and unin-

tentional injuries. Moreover, CDC’s National Center for Injury Prevention and Control offers details of best practices and strategies for injury prevention and safety promotion.

### ADDRESSING THE CHALLENGES

The Fogarty International Center (FIC) of the National Institutes of Health (NIH) convened an expert panel in Bethesda, Md, in July 2003 to consider the challenges posed by trauma and injury in low/middle-income countries and potential actions to address these challenges. This meeting brought together 40 experts in the field of trauma and injury from Eastern Europe, South and Southeast Asia, Latin America, sub-Saharan Africa, Canada, and the United States. These individuals were affiliated with university research units, hospitals, government agencies, and nongovernment groups. The goal was to discuss needs and priorities for research and training and the development of

new technologies designed to reduce the burden of trauma and injuries in low/middle-income countries.

Approximately one third of the panel members either were working in or had ongoing research collaborations in low/middle-income countries. Major topics addressed included the following: research gaps and training needs related to intentional and unintentional injuries in low/middle-income countries; basic science and options related to diagnosis and treatment of injury, wound care, wound healing, spinal injury, brain injury, and orthopedics; ethical challenges involved in conducting trauma research; capacity building; and mental health issues related to trauma and injury.

The meeting was sponsored by FIC and its partners: the National Institute of General Medical Sciences; the National Institute of Child Health and Human Development; the National Institute of Mental Health; the National Institute of Biomedical Imaging and Bioengineering; the

National Institute of Neurological Disorders and Stroke; the National Heart, Lung, and Blood Institute; and the National Institute on Disability and Rehabilitation Research of the Department of Education. This broad base of interest demonstrated the increasing recognition of the burden caused by trauma and injury and the need to promote research and training in the field.

## STATUS OF RESEARCH IN LOW/MIDDLE-INCOME COUNTRIES

A consistent theme identified by the panel members was the paucity of data available. The number of epidemiologists and other trained researchers in low/middle-income countries who conduct trauma and injury research is extremely limited, and there is little funding support. There is a lack of data on road traffic injuries, and data in such areas as suicide, interpersonal violence, and violent crime are even more scarce. Without such data, public officials cannot be expected to recognize trauma and injuries as serious public health problems.

Further compounding the challenges faced by researchers focusing on trauma and injury, clinicians who might otherwise participate in research efforts are overwhelmed by the burden of infectious diseases and struggle to provide high-quality care in facilities lacking basic equipment and supplies. They have neither the time nor the training that would enable them to effectively participate in research.

The panel members emphasized the fact that conditions in low/middle-income countries are heterogeneous and that injury patterns observed in these

countries are different from those seen in high-income countries. For example, in resource-constrained settings, most road traffic injuries involve pedestrians. Therefore, educational interventions may be an important strategy to reduce road traffic injuries; research will be required for validation of such interventions. Similarly, hazards—such as landmines—rarely seen in high-income countries create unique needs in regard to developing low-cost technologies for trauma patients (e.g., low-cost imaging diagnostic methods and prosthetic devices that can be made quickly and developed from local materials). Once these technologies are identified, they may benefit global populations more broadly.

Other critical gaps include the absence of organized and trained emergency medical services in most low/middle-income countries. This situation lengthens the critical time interval before trauma victims are treated, contributing to increased morbidity and mortality. Even in the largest hospitals in these countries, internationally accepted guidelines for treatment of trauma and injuries are often not followed, diagnostic and imaging facilities are poorly equipped, resources are strained, and treatment practices routinely used in high-income countries are not being implemented. For example, advances in resuscitation, wound-closing procedures, and infection control have greatly increased the survival of children in the United States who experience massive burns; however, these practices are not yet commonly used in low/middle-income countries.

In addition to issues involving prehospital and hospital care, other critical issues must be addressed, including the mental

health effects of exposure to physical violence, trauma, and injury. These effects most often take the form of posttraumatic stress disorder and depression, and both victims and their families are affected. Furthermore, injuries create a need for immediate rehabilitation, and they often result in long-term disability that affects patients' productivity and the well-being of their families. Major knowledge gaps in each of these areas restrict the efficacy of interventions. Research is needed to inform policymakers, improve clinical practice, and contribute to advances in knowledge.

## A RESEARCH AGENDA

Meeting participants emphasized that each country is unique and that aside from gross domestic product, the defining factor separating low-, middle-, and high-income nations, growing inequities exist within countries themselves. An understanding of the research infrastructure and cultural characteristics of each nation is an essential factor in conducting research. As such, there is a need to build stronger science bases in low/middle-income countries that would allow local needs to be addressed. Participants recommended the following areas of research (not listed in order of importance) as most critical.

1. *Epidemiology*: A broad spectrum of epidemiological and surveillance research is needed to enhance knowledge regarding trauma and injury risks relevant to low/middle-income countries. Such research will document the causes, extent, and nature of trauma and injuries and will focus the attention of policymakers and planners on this area. Because of the challenges involved

in conducting research in low/middle-income countries, innovative surveillance data collection strategies are needed that would improve on existing systems. Such strategies could include improved clinician reporting mechanisms, development of common definitions of the causes and nature of injuries, identification of minimum data sets required, and use of distributed data collection and analysis procedures.

2. *Basic science*: To improve diagnosis and treatment, innovative strategies, including low-cost imaging techniques and safe, effective, and inexpensive blood substitutes, need to be developed. Efforts should be focused on both development of new interventions and research on how to effectively modify existing ones according to local needs. Research is required to adapt existing clinical guidelines to low/middle-income countries and to evaluate the efficacy of surrogate methods for diagnosis and localization of injuries.

3. *Prevention research*: Studies are needed if there is to be a better understanding of the context in which trauma and injury occur in low/middle-income countries, as well as human risk-taking factors that increase the likelihood of trauma and injury. This includes qualitative research focusing on how trauma- and injury-related technology transfer from high-income to low/middle-income countries may be enhanced, studies addressing the development and evaluation of public education strategies about road safety for pedestrians, and outcome studies documenting the effectiveness of primary prevention.

4. *Health services research*: Outcomes and costs of current trauma care systems need to be

documented in research exploring innovative and cost-effective ways to provide low-cost diagnosis and treatment options to trauma and injury victims. For example, defining the effects of major treatment elements such as prehospital care, use of internationally accepted treatment guidelines, and hospital treatment policies on patient outcomes is essential in terms of policy decisionmaking. Because rural areas shoulder much of the burden of injury, a concerted effort to develop and evaluate innovative strategies to provide trauma care or mental health care through informal systems in remote areas is a high priority. Research designed to help in identifying the most effective ways to implement best practices (e.g., in the area of control of bleeding) under the local conditions present in low/middle-income countries needs to be promoted and supported.

5. *Policy research:* Participants identified obstacles to governments' understanding of and commitment to injury prevention control and treatment and how to develop a more effective policy process for increasing the visibility of trauma and injury on the national health policy agenda as important areas of endeavor. In each country and region, several stakeholders will influence the translation of research to policy and, subsequently, to effective implementation. Those conducting policy research should take into account the stakeholders involved in the area of injury prevention and control, including decisionmakers in the fields of transportation, law enforcement, and education and regulators in the field of occupational health.

Local research that assesses the magnitude of the problem

and the role and function of each component of an effective injury response system will allow possible high-risk groups to be identified and will illustrate the economic benefits of providing intervention and prevention services. Research on how to educate the media and the public in different settings will also be needed.

6. *Ethical considerations:* Finally, as new research on trauma and injury in low/middle-income countries is pursued, it is critically important to address the many ethical questions that arise in treating victims of trauma and injury who may not be able to provide informed consent at their entry into a study. Furthermore, general ethical issues involved in conducting research in these countries must be addressed.

## BUILDING RESEARCH CAPACITY

The panel members urged additional support for training of scientists and clinicians in this field. Researchers in low/middle-income countries also need the support of trained personnel such as trauma registrars, data quality assurance staff, and field supervisors. For this reason, and to develop the skill base of a broad array of research roles, short courses and distance learning may be appropriate strategies to explore. The participants were particularly supportive of training in close linkage to research and a global partnership model.

One such mechanism pursued by the FIC and its NIH partners, as well as other US government agencies, is establishing stable long-term research and training collaborations between academic and medical centers in the

United States and their counterparts in low/middle-income countries. In some cases, these collaborations might involve funding for specific degree program training either locally or abroad; in other cases, training might most effectively take place in the context of research.

## CONCLUSION

Causes and consequences of injury and trauma vary from country to country. Thus, prevention and treatment strategies should be tailored accordingly. A coordinated response and increased resources from multisectoral stakeholders, including research funding agencies and donors around the world, are required if we are to meet the critical needs in this field and prepare for the growing burden. The FIC will continue to work with a range of agencies and with scientists in low/middle-income countries to address the growing burden of trauma and injury. This work will reap benefits for individuals, families, and communities both in the United States and globally. ■

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## Contributors

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