Manual for estimating the economic costs of injuries due to interpersonal and self-directed violence

World Health Organization

and

DEPARTMENT OF HEALTH AND HUMAN SERVICES
CENTERS FOR DISEASE CONTROL AND PREVENTION

Manual for estimating the economic costs of injuries due to interpersonal and self-directed violence

A Butchart, D Brown, A Khanh-Huynh, P Corso, N Florquin, R Muggah

World Health Organization

and

DEPARTMENT OF HEALTH AND HUMAN SERVICES
CENTERS FOR DISEASE CONTROL AND PREVENTION

WHO Library Cataloguing-in-Publication Data

Manual for estimating the economic costs of injuries due to interpersonal and self-directed violence. / A Butchart, D Brown, A Khanh-Huynh, P Corso, N Florquin, R Muggah.

1.Violence – economics. 2.Interpersonal relations. 3.Wounds and injuries – economics. 4.Domestic violence. 5.Guidelines. I.World Health Organization. II.Centers for Disease Control and Prevention (U.S.).

ISBN 978 92 4 159636 7 (NLM classification: WA 308)

Designed by minimum graphics.
Printed in France

Contents

Foreword

Every day, children, women and men live inside their homes with the fear of violence by close family members. In many communities, all around the world, young people are afraid of violence on the way to school, the local store or the café. Every year, millions of people take or attempt to take their own lives. Such acts of violence cause enormous shock and suffering. They often change the lives of individuals, families and communities for ever.

In addition to the wide-ranging emotional costs, violence also causes substantial financial damage. Fatal and non-fatal injuries due to interpersonal and self-directed violence result in large direct expenditures for the health care, law enforcement, criminal justice and welfare systems. Meeting these direct costs diverts huge quantities of money from more constructive societal spending. Far larger still are the indirect costs of violence-related injuries that arise from lost productivity and an inability to continue with the activities of daily life. These massive indirect costs result in slower economic development, increased socioeconomic inequality, and an erosion of human and social capital.

Violence does not need to be accepted as a fact of life. It can be prevented by implementing programmes that address its root causes. Information on the economic costs of violence is often essential in convincing policy-makers of the importance of intervening and the possible savings that could result from prevention programmes.

Some countries have made progress in documenting these economic costs, and using the findings to advocate for increased investment in prevention. In most countries, however, systematic research into the economic impact of violence is almost totally lacking.

This manual provides a simple set of guidelines for estimating the economic costs of injuries due to interpersonal and self-directed violence. It is hoped that this guidance will support a growing number of scientific analyses of the economic impacts of violence, and ultimately result in additional prevention programmes and lives saved.

Etienne Krug
Director, Department of Violence and Injury Prevention and Disability
World Health Organization, Geneva, Switzerland

Acknowledgements

Authors

This manual was written by Alexander Butchart, David Brown and Alexis Khanh-Huynh of the World Health Organization's Department of Violence and Injury Prevention and Disability, Geneva, Switzerland; by Phaedra Corso of the Centers for Disease Control and Prevention, Atlanta, GA, USA; and by Nicolas Florquin and Robert Muggah of the Small Arms Survey at the Graduate Institute of International and Development Studies, Geneva, Switzerland. Technical editing was by Frank Theakston.

Case studies

The case studies presented in Section 5 of this manual were conducted by the following people.

- Brazil: AT Miranda Soares de Moura, G Loureiro Werneck and M de Sousa Nascimento, Institute for Religious Studies, State University of Rio de Janeiro, Federal University of Rio de Janeiro.
- Jamaica: E Ward and A Grant, Jamaica Ministry of Health, Health Promotion and Protection Division and Jamaica Violence Prevention Alliance, Kingston.
- Thailand: K Bundhamcharoen, P Odton, S Mugem, S Phulkerd, K Dhisayathikom and V Tangcharoensatien, International Health Policy Program, Bangkok.

Other contributors

The document reflects the input of many other health economists and public health experts from Australia, Brazil, Jamaica, Kenya, Mexico, the Netherlands, South Africa, Thailand, Uganda, the United Republic of Tanzania, the United States and WHO, through their participation in an expert meeting at WHO in Geneva in April 2005, a pilot training workshop in Entebbe, Uganda in June 2007 and peer review of the draft text.

Funding

The development and publication of this manual has been made possible through the generous financial support of the Centers for Disease Control and Prevention.

1. Introduction

1.1 Background

The World Health Organization (WHO) recognizes violence as a significant contributor to the overall burden of disease and injury. A recent WHO report (*1*) highlights the enormous economic burden of interpersonal violence. Two issues of concern were raised in the development of that report. First, there are few studies examining the economic burden of interpersonal violence in developing countries, where the burden of violence is heaviest.[1] Second, the report found large variations in the methodologies used to cost interpersonal violence, thus limiting comparability across studies.

These two issues point to a clear need for rigorous methodological guidelines to cost violence, especially in the context of developing countries. To address this need, WHO and the Centers for Disease Control and Prevention (CDC) in the United States decided to prepare this manual, which provides a standardized set of recommendations to estimate the direct and indirect economic costs of interpersonal and self-directed violence. On 4 and 5 April 2005, WHO hosted an expert meeting in Geneva to guide the preparation of the manual. Experts from Australia, Jamaica, Mexico, the Netherlands, South Africa, Thailand and the United States, together with WHO staff, participated in the meeting to ensure that the manual would be of global relevance and use. Based on the recommendations of the meeting, WHO and CDC then worked with the Small Arms Survey project at the Graduate Institute of International and Development Studies, Geneva, in drafting the manual, which has been extensively peer reviewed. Centres in Brazil, Jamaica and Thailand carried out pilot case studies to test the applicability of the recommendations in a variety of contexts.

1.2 Rationale for estimating the economic costs of violence

Approaches to estimating the burden of disease have generally been confined to health effects on individuals. These include mortality rates and indices that combine measures of survival and quality of life, such as the disability-adjusted life year. This is a composite index derived from the person-years of life lost and years lived with disability. One disability-adjusted life year is one year of healthy life lost, due either to death or disability, and the indicator is used to quantify the loss of healthy life due to injury or disease. Violence is a complex problem with consequences for individuals, the family, communities and society at large. It is a challenge to estimate the burden of violence in a way that realistically reflects its impact. One such way is to estimate its economic burden.

The main value of economic cost estimates for violence is *within* countries. A host of

[1] In 2000, the estimated rate of violent death in low- and middle-income countries was more than twice that in high-income countries.

factors – not least the fact that the economic value of a human life is relative to a country's gross domestic product (GDP) – make it challenging to meaningfully compare the costs of violence between countries. Within countries, estimates of the cost of violence can serve as reference points for resource allocation and priority-setting. Cost estimates can ensure that violence prevention is ranked equitably in terms of investment. Also, estimates of the cost per case of violent events or episodes can be used in economic evaluations such as cost–benefit and cost–effectiveness analyses. This can be the first step towards exploring the benefits of potential interventions aimed at preventing violence and ensuring that the most effective and cost-effective interventions are being applied in violence prevention. Measuring the overall cost of violence is also important for the purposes of advocating for prevention.

To guide policy and practice, costing studies often seek to answer one or several of the following questions.

- What is the cost of violence, particularly from a public health point of view?
- How do the costs of violence compare to those of other types of injury (e.g. road traffic injuries) and other preventable causes of death?
- What levels and types of cost are generated by the different types of violence (e.g. youth violence, child abuse, self-directed violence)?
- Which population groups bear the greatest burden (e.g. by gender, age)?
- Do the mechanisms used in violent incidents (e.g. firearms, sharp instruments) affect the costs of violence?
- What are the potential economic benefits of an intervention aimed at reducing or preventing violence?

1.3 Objectives of the manual

The manual provides a general framework for economists, public health experts and researchers interested in conducting studies that can provide an estimate of the economic burden of injuries due to interpersonal and self-directed violence. It is intended to assist countries in estimating the overall costs of injuries due to violence. Taking into account the data limitations that the majority of countries face, the manual identifies a minimum set of data required to produce general estimates of direct medical costs and loss of productivity. In some settings, obtaining even the minimum set of data may require creative and innovative solutions. Options for further disaggregating these estimates, and for documenting the impact of violence on quality of life, are included as additional modules for those countries or researchers wishing to capture some of the more complex dimensions of the individual and social costs of violence.

It is important to note at the outset that this manual focuses on the costing of injuries related to interpersonal and self-directed violence, and does not address the costs of non-injury outcomes that may be long-lasting and extend throughout life. For instance, exposure to maltreatment and related stressors experienced during childhood has a strong, graded relationship to a wide variety of health and social problems from adolescence to adulthood (*2*,*3*). Such exposure has been associated with increased health service utilization and subsequent costs in adulthood (*4*,*5*). Study of the lifelong costs of interpersonal and self-directed violence is an area of great importance that has not been extensively explored. That is not the focus of this manual, however.

1.4 Target audiences

The primary target audience of the manual includes public health agencies, policy-makers, and researchers specializing in the fields of burden of disease estimates, health economics, and violence and injury prevention, particularly those working in low- to middle-income countries and low-resource settings.

2
Defining violence and measuring its occurrence

2.1 Defining violence

WHO (*6*) defines violence as:

> The intentional use of physical force or power, threatened or actual, against oneself, another person, or against a group or community, that either results in or has a high likelihood of resulting in injury, death, psychological harm, maldevelopment or deprivation.

A key concept in the above definition is intent, irrespective of the outcome that an act of violence produces. In addition to recognizing injuries and death as possible outcomes of physical force, this definition also recognizes psychological harm, maldevelopment and deprivation as possible outcomes of violence.

In 1996, in resolution WHA49.25, World Health Assembly declared violence a leading public health problem and called on WHO to develop a typology that characterized the different types of violence and the links between them. The typology proposed in the World report on violence and health (*7*) divides violence into the following three broad categories according to the characteristics of those committing the violent act:

- self-directed violence
- interpersonal violence
- collective violence.

This first level of categorization differentiates between violence that a person inflicts upon himself or herself (self-directed), violence inflicted by another individual or by a small group of individuals (interpersonal) and violence inflicted by larger groups such as states, organized political groups, militias and terrorist organizations (collective). Owing to the special methodological challenges of obtaining public health data in contexts affected by collective violence, this manual focuses on ways to estimate the economic costs of fatal and non-fatal interpersonal and self-directed violence.

Self-directed violence

Self-directed violence is subdivided into suicidal behaviour and self-abuse. The former includes suicidal thoughts, attempted suicide – also called "parasuicide" or "deliberate self-injury" in some countries – and completed suicide. Self-abuse, in contrast, includes acts such as self-mutilation.

Interpersonal violence

There are two subcategories of interpersonal violence, depending on the relationship between the perpetrator(s) and the victim(s) and the setting where the violence occurs: family and intimate partner violence and community violence.

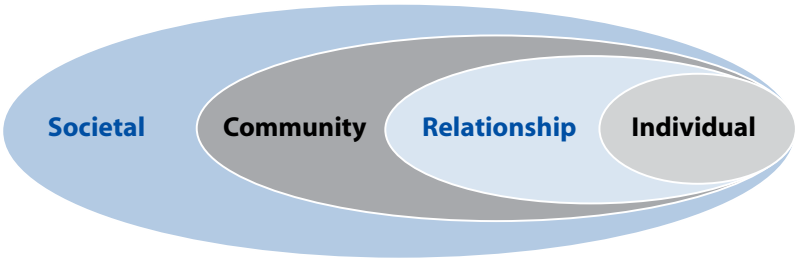
- Family and intimate partner violence includes abuse or maltreatment of children, intimate partners and elderly family members, usually (though not exclusively) occurring in the home.
- Community violence includes youth violence, rape or sexual assault by strangers, and violence in institutional settings – in other words, violence between individuals who are unrelated and who may or may not know each other, and generally taking place outside the home.

2.2 Understanding interpersonal and self-directed violence

The ecological model

To place in context efforts to estimate the economic dimensions of violence, it is useful to understand the risk and protective factors that increase (or reduce) the likelihood of people becoming victims or perpetrators of violence. The ecological model provides a framework for understanding the many factors that contribute to violence. It assumes that violence is caused by the interaction of factors at four levels: individual, relationship, community and societal (Fig. 1). Interventions to prevent or reduce violence seek to address one or several of these levels (*7*).

Fig. 1 Ecological model for understanding violence



Source: World Health Organization (*7*).

At the individual level, the ecological model considers biological and personal history factors that might influence a person's behaviour. These include age, income, educational attainment, psychological and personality disorders, history of abuse and substance abuse.

At the relationship level, the model considers close relationships and how these increase the risk of being a victim or perpetrator of violence. Factors include poor parenting practices and family dysfunction, marital conflict around gender roles and resources, and associating with friends at risk of engaging in violence.

At the community level, the model considers the contexts in which close relationships take place, such as neighbourhoods, schools, workplaces and other institutions. Poverty, high residential mobility and unemployment, social isolation, unrestricted or poorly restricted access to alcohol, and the existence of a local drug trade increase the risk of violence.

At the societal level, the model considers the factors embedded in the larger society that influence rates of violence. Such factors include cultural norms and attitudes that support the use of violence, broad economic, social, health and education policies that maintain or increase economic social inequalities, the availability of firearms and other weapons, and weak criminal justice systems that leave perpetrators effectively immune to prosecution.

Direct and indirect costs

Any attempt to estimate the costs of violence must recognize that violence affects societies at all levels, as opposed to only the victims and perpetrators. Studies documenting the economic effects of violence have therefore covered a broad range of costs affecting individuals and society as a whole, as shown in Table 1.

When categorizing the costs of violence it is useful to distinguish between direct and indirect costs (*1*,*8*–*10*). Direct costs arise directly from acts of violence and require actual payments by individuals or institutions. They can be further divided into medical and non-medical costs, given the importance of documenting the costs of medical treatment for injuries resulting from violence. Direct medical costs generally include those for hospital treatment, outpatient visits, ambulance or other transport to hospital,[1] physician fees, drugs and laboratory tests.[2] Direct non-medical costs include those incurred by the criminal justice system, such as those associated with policing and imprisonment, legal services, foster care and private security measures.

Indirect costs refer to lost resources and opportunities resulting from violence. Studies tend to focus on tangible costs such as reduced productivity or output by the victim, which is usually calculated from average gross earnings and the amount of work time lost as a result of violence (as will be noted later, age/sex-specific wages are preferred). In some settings, it may be appropriate to incorporate the reduced productivity of a caregiver.[3] Other tangible costs include lost investments in social capital (e.g. education of the victim and perpetrator), life insurance costs, reduced productivity or output by the perpetrator, and macroeconomic costs (such as a reduction in property values or foreign investment due to violence). Also included in indirect costs are intangible costs such as reduced quality of life. Quality of life includes many components, such as job opportunities, access to schools and public services, and participation in community life. In the context of violence, it is usually associated with health-related quality of life, which includes the pain and suffering, both physical and psychological, that arises from violent incidents.

This manual considers the components that make up direct medical costs and loss of productivity as core requirements. Estimating the impact of violence on quality of life, and disaggregating costs by gender, age, intent, type of injury and mechanism are suggested as optional modules for further analysis.

2.3 Health policy questions that can be addressed by economic impact studies of violence

It should be noted that, because the direct and indirect cost components listed in Table 1 refer to different underlying quantities of interest or levels of the economy, the meaning of a combined estimate (direct + indirect) is unclear (DB Evans et al., unpublished data, 2007). It is therefore recommended that the components are kept separate, and that only the indirect cost component involving market production (e.g. formal labour force) is expressed as a percentage of GDP (DB Evans et al., unpublished data, 2007).

With these limitations in mind, health policy questions that can be addressed by economic impact studies using the methodology outlined in this manual include the micro- and macro-level questions set out in Table 2.

---

[1] In discussion with colleagues in several African countries, it was noted that an ambulance is not necessarily the primary means of getting to hospital. In many low- and middle-income settings, a person in need of medical attention may use a taxi, a neighbour's car or even a horse or mule to get to a hospital or clinic.

[2] Please refer to Finkler (*11*) for a full discussion of the need to be aware of the difference between medical costs and medical charges.

[3] In discussion with colleagues in several African countries, it became clear that a spouse, family member or friend would often have to serve as a caregiver during a stay in hospital, since nurses and hospital support staff are often in short supply.

Table 1. A typology for costing violence

COST CATEGORY	TYPE OF COST	COMPONENTS	DISAGGREGATION OPTIONS
Direct	Medical	Hospital inpatient Hospital outpatient Transport/ambulance Physician Drugs/laboratory tests Counselling	By demographic group By type of injury By mechanism By intent
	Non-medical	Policing and imprisonment Legal services Foster care Private security	
Indirect	Tangible	Loss of productivity (earnings and time)[a]	
		Lost investments in social capital Life insurance Indirect protection Macroeconomic	
	Intangible	Health-related quality of life (pain and suffering, psychological)	
		Other quality of life (reduced job opportunities, access to schools and public services, participation in community life)	

[a] Loss of income by the victim, the perpetrator and caring personnel are some examples. Only income lost by the victim is taken into account in these guidelines.

Note: Cost component categories highlighted in grey are the minimum requirements set by the manual. Those highlighted in blue are the optional modules. Those not highlighted are not covered in the manual.

Source: Adapted from World Health Organization (*1*).

Table 2. Health policy questions that can be addressed by economic impact studies of violence

LEVEL	QUESTION
Micro	
Households	■ What impact do violence-related deaths, injuries and illness have on a household's income? (*Sometimes this question covers a single year, sometimes a longer period of time.*) ■ How much do people pay for medical or other expenses because of violence-related deaths, injuries and illness? (*This question may cover an episode, a year or a lifetime.*)
Firms	■ What impact do violence-related deaths, injuries and illness have on the operating costs, output or profit of a firm? ■ What is the relative impact of violence-related injury and ill-health on productivity in the workplace? (*This might include impaired performance while still at work, as well as absenteeism.*)
Government	■ What proportion of government expenditure could have been saved and directed to an alternative use in the absence of violence? (*Sometimes this question covers only a subset of government, such as the health service costs that could be avoided by the prevention of violence-related injuries.*) ■ What impact do violence-related death, injury and illness have on the government workforce and on the government's ability to provide services?
Macro	
Society	■ What impact does violence have on GDP and its rate of growth? ■ How much does society pay for medical and other expenses because of violence-related death, injury and illness? ■ What impact does violence have on social welfare?

Source: Evans DB et al, unpublished data, 2007.

2.4 Ethical issues

Estimating the value of human life may appear both impossible and unethical. Individual productivity estimates, as one way of placing a value on human life, are likely to be much higher in high-income than in low- or middle-income countries. This creates the false yet uncomfortable impression that a life is worth more in some contexts or among specific sociodemographic groups (see, for instance, Kuchler & Golan (*12*) and Transport Research Laboratory (*13*)). It must therefore be stressed that this manual does not assume that it is possible to generate a numerical value of life that can be compared across widely differing socioeconomic groups. Rather, it reviews possible methods for better understanding the economic burden associated with violence and the value of initiatives aimed at preventing and reducing violence.

3.
Methodological approaches to estimating the magnitude and costs of violence-related injuries

This section reviews the main methodological approaches used in the literature to estimate the magnitude and costs of injuries due to violence and other causes. While all the approaches reviewed are valuable in the contexts in which they have been used, the manual will draw primarily on those that appear most applicable in settings where data availability and quality may be limited. Direct medical costs will be calculated by multiplying the number of new violence-related injuries in a given period by unit costs. Indirect costs will be estimated by multiplying the amount of productive time lost among victims by their income (wage rate). This is known as the human capital approach. This section explains why these approaches were selected rather than others.

3.1 Incidence- vs prevalence-based estimates [1]

The first step in producing an estimate of the economic burden of violence-related injuries is to determine whether annual or lifetime costs are being assessed. Deciding this will determine which incidents and costs of injury should be counted during the period under study and what the time period should be.

One approach is to measure the lifetime costs of injuries that occurred during a particular period, for example one year. Using this bottom-up approach typically requires counting all new injuries that occurred during a year, and estimating the costs of these injuries during that year and beyond. Because the value of a currency in 10 years' time will not be the same as the value of that currency today, future costs must be adjusted (by discounting) to give their present value. Lifetime cost estimates are generally derived from counts of new violence-related deaths and injuries seen at hospitals and emergency departments within a specified period, although the same technique could also be applied to all existing injuries, both old and new.

Another approach is to estimate costs of injuries for a given period, typically a year, regardless of when the injuries first occurred. These estimates usually rely on a top-down approach by determining, for example, the proportion of annual budgets and expenditures that can be attributed to injuries.

The choice of an approach depends on the economic question that the study sets out to answer. This manual seeks to determine the total costs – current and future – of violence-related injuries that occur over a determined period, such as one year. It thus seeks to document all medical costs for each new incident as well as future losses in productivity and human capital, which cannot be captured using a top-down approach that relies on annual national health expenditures. Furthermore, most countries' injury surveillance systems are likely to better record incidence than prevalence data, especially when it comes to identifying the cause of injury and intent. For these reasons,

[1] For further reading, see Rice (*14*), Byford, Torgerson & Raftery (*15*) and Choi & Pak (*16*).

this manual recommends adopting a bottom-up approach that assesses the incidence of violence-related injury within a specific period of one year, and the associated lifetime costs.

3.2 Human capital, friction cost and willingness to pay [1]

There are three main approaches to estimating the indirect costs of injuries: the human capital, friction-cost and willingness-to-pay approaches.

The human capital approach

This approach measures the value of time lost due to absence from work or reduced productivity. The estimation is based on the following equation:

Indirect cost due to injury = time lost due to injury × wage rate

For fatalities, in the absence of detailed estimates, time lost is measured in years. For non-fatal injuries due to violence, time lost is measured in days. Estimations of wage rates (i.e. per capita income) are obtained for selected age/sex groups. In the absence of age/sex-specific wage rates, average national wage rates may be used. Although average national wage rates may equally value the time and lives of individuals in different occupational and earning categories, this method may not account for lost market productivity in the presence of non-random distributions of injury burden in the population (D.B. Evans et al., unpublished data, 2007). Information on the employment status and occupation of injury victims is also valuable in adjusting estimates of lost productivity costs. In the case of unpaid work, such as housekeeping, estimated values need to be imputed. Valuation of unpaid work is discussed in Section 4.1.

The friction-cost approach

This approach measures the indirect cost of injury by estimating the cost of replacing those killed or temporarily or permanently disabled with other existing workers. For example, in the case of fatalities due to violence, the work could be taken on by individuals who were previously unemployed. The "friction cost", then, is the cost of recruiting and training new employees, loss of production during the time it takes to replace the workers (the "friction period") and some medium-term economic consequences after the friction period. In essence, this approach values the cost involved in replacing the killed or injured person to restore the previous production level. It broadly assumes that there are others more or less willing and able to take the killed or injured person's place. Nonetheless, the friction-cost approach appears less well adapted to low- and middle-income countries than the human capital approach, since it requires more data and is challenging to apply with respect to unpaid work.

The willingness-to-pay approach

This approach assumes that the value of a health benefit equals the value that all affected individuals place on the improvement of their condition. The value of a health benefit is the total sum of what people are willing to pay for it. In terms of violence prevention, the cost of a violent incident is the total sum of what individuals are willing to pay to reduce the risk of becoming a victim. There are two ways of estimating willingness-to-pay values. One is through surveys asking individuals how much they would pay to

[1] See also Kuchler & Golan (*12*) and Transport Research Laboratory (*13*).

make certain that something would not happen to them. The second involves observing "averting behaviour", in other words actual cases in which individuals undertake preventive measures to avoid exposure or mitigate the effects of injury. Investments made in preventive measures are then used as a proxy for individual willingness to pay to avoid a particular injury.

Why use the human capital approach?

Since the manual is intended to be applicable in the widest possible number of low-, middle- and high-income countries, data availability is a key concern. For this reason, the friction-cost approach appears inappropriate. While the willingness-to-pay approach can capture "humane" considerations such as pain and suffering, the research tools involved (surveys) are usually conceived for adults and are more difficult to use with younger populations, which nevertheless represent a significant proportion of those affected by injuries (*13*). More importantly, the willingness-to-pay values can generate prohibitive cost estimates even for adults, as it is often difficult to conceptualize the small changes in risk referred to in such surveys. The manual therefore follows a human capital approach.

3.3 Estimating the incidence of fatal and non-fatal violence-related injuries

Estimating the economic costs of violence-related injuries requires data on incidence and on costs. Incidence data refer to the number of violent injuries to be considered in the cost estimate. Such data can be disaggregated according to intent, severity of the injury, age and sex of the victim and mechanism. Costing data include information on the unit costs associated with each type of injury. Depending on availability, costing data can be obtained for different types of injury, based on severity and mechanism. As will be explored further, key cost indicators include length of stay, average cost per hospital bed-day, number of inpatient visits, age at death, average life expectancy and wage rate. Incidence is multiplied by unit costs to obtain total costs.

The more disaggregated the incidence and costing data, the more accurate the estimate will be. The need for a high level of accuracy depends, however, on the overall objective of the study to be undertaken. The minimum requirements established in this manual aim at comparing the costs of violence-related injuries to the national public health budget or to the budgets for other public health problems. Such general estimates are mostly intended for purposes of advocacy and broad public policy priority-setting. The optional modules provide a basis for more detailed examinations of the nature of the costs, and can help identify areas that require a particular intervention. These can include a specific type of violence, a particular cost category, the availability of weapons such as firearms or a demographic group that is particularly at risk. Quality-of-life estimates also provide a useful benchmark in low- to middle-income contexts where the consequences of violence cannot fully be described by estimating their economic costs.

4. Guidelines

This section outlines the basic data requirements and calculations necessary to generate an estimate of direct medical costs and loss of productivity due to violence-related injuries. Based on the degree of specificity of the available data, however, researchers may wish to refine their cost estimates. For example, in some contexts it may be feasible to apply specific direct medical costs based on the mechanism used, intent, or the victim's demographic group (see "Disaggregating minimum data requirements" in Section 4.2). The minimum data requirements outlined below should therefore be used as a *flexible framework* allowing for further investigation and analysis wherever the data permit.

4.1 Minimum data requirements

Incidence data

The first step in producing an estimate of the costs of injuries is to determine which cases are to be considered for the period under study (e.g. one year). As discussed above, the manual is concerned with fatal and non-fatal injuries due to interpersonal and self-directed violence. The 10th revision of the International Statistical Classification of Diseases and Related Health Problems (ICD-10) (*17*) provides useful descriptions of what is included under these types of violence. The ICD-10 codes that should be referred to are the following:

- interpersonal violence (codes X85–Y09)
- self-directed violence (codes X60–X84)
- undetermined (codes Y10-Y34).

The severity of an injury will partly determine its costs. Previous practice has shown that injuries can usefully be classified into three categories: fatal, serious and slight. The manual recommends that, as a minimum, violence-related injuries are categorized based on the definitions for injury severity provided below. For each definition, the codes in parentheses (I1, I2, K1, etc.) refer to the costing equations in Table 3 and Figure 2.

- A *fatal* injury is one in which the patient dies as a result of the incident, provided death occurs within 30 days (I1 = incidence of fatal violent injuries). Death registries, mortuary and hospital records, and coroner/medical examiner reports are to be consulted to obtain this data, and can be cross-checked with other sources such as police statistics for homicides. It should be noted, however, that there is usually not a very high degree of correspondence between these data sources.
- A *serious* injury is one that does not cause the patient's death within 30 days but is serious enough for the victim to be admitted to hospital as an inpatient (I2 = incidence of serious violent injuries). Hospital admission registers will be the main source of data.

- A *slight* injury is one that requires an emergency department (ED) visit but is not followed by hospital admission (I3 = incidence of slight violent injuries). Incidence of slight injuries can be derived from ED registers, records or logbooks.

Other categories of injury severity, such as those that do not require hospital or ED treatment but require another form of outpatient care, and those for which no care is sought but for which loss of productivity may occur, are more difficult to quantify. If the objective of the study is to cost all violence-related injuries, however, data can be obtained through a household survey.

Direct medical costs

The medical costs resulting from violence-related injuries arise from medical or hospital treatment (inpatient and outpatient) and the use of ambulances or other means of transportation to hospital. In addition to the violent incident data described above, required information to calculate direct medical costs includes:

- the average cost per medico-legal investigation of violence-related deaths (K1);
- the percentage of violence-related deaths subject to medico-legal investigation (K2);
- the average unit cost for transportation to the ED (e.g. average unit cost incurred by ambulance service) per ED visit or hospital admission (M1);
- the percentage of fatal violence-related injuries involving hospital admission (M2);
- the average length of stay in hospital (in days) for violence-related injuries as defined above (M3);
- the average cost per bed-day of hospital treatment, including "hotel costs", physician fees, operations, blood transfusions, tests and examinations (e.g. X-rays), and drugs (M4);
- the percentage of ED visits due to violence-related injury as defined above that required transportation (e.g. by ambulance) (M5);
- the average cost of medical treatment in the ED per ED visit (M6);
- the percentage of hospital admissions for serious violence-related injuries that are admitted through ED (M7); and
- the percentage of fatal violence-related injuries involving an ED-visit (M8).

Some of this information may be published by ministries of health or be available from private health facilities.[1] Data such as the average cost per bed-day of hospital treatment may not be easily available, in which case the WHO-CHOICE (CHOosing Interventions that are Cost Effective) econometric model for estimating country-specific hospital costs may serve as a useful reference point.[2] Table 3 lists the required data and basic costing equations for calculating direct medical costs, and Fig. 2 provides an overview of these costing equations and the underlying calculations.

Loss of productivity

Injuries result in lost productivity owing to the reduced activity (or, in the case of fatal injuries, permanent inactivity) of individuals who would otherwise be generating an income. The basic data requirements for estimating lost productivity are as follows:

---

[1] When both sources are available, researchers will need to make an informed judgement on which cost values are most representative. In general, private costs are likely to be higher than public costs, but also more representative of actual costs for the public system.

[2] See http://www.who.int/choice/en. The model can predict the estimated cost per hospital stay and per outpatient visit by hospital level (primary, secondary and tertiary). Unit costs are specific to public hospitals with an occupancy rate of 80% and represent the hotel component of hospital costs, i.e. excluding drugs and diagnostic tests and including other costs such as personnel, capital and food costs.

Table 3. Direct medical costs: required data and basic costing equations

SEVERITY OF INJURY	REQUIRED DATA	BASIC COSTING EQUATION
Fatal (C1)	I1, K1, K2, M1, M2, M3, M4, M5, M6, M8	C1 = I1 × [(K1×K2) + (M1×M5) + (M2×M3×M4) + (M6×M8)]
Serious (C2)	I2, M1, M3, M4, M5, M6, M7	C2 = I2 × [(M6×M7) + (M1×M5) + (M3×M4)]
Slight (C3)	I3, M1, M5, M6	C3 = I3 × [(M6) + (M1×M5)]

Fig. 2 Overview of direct medical costing equations and underlying calculations

Fatal injuries

$$C1 = I1 \times [(K1 \times K2) + (M1 \times M5) + (M2 \times M3 \times M4) + (M6 \times M8)]$$

- I1: No. of fatal injuries
- K1: Cost / Medico-legal investigation
- K2: No. of medico-legal investigations / 100 fatal injuries
- M1: Transport cost / ED/hospital visit
- M2: No. of ED visits / 100 fatal injuries
- M3: No. of hospital admissions / 100 fatal injuries
- M4: Hospital days / Hospital admission
- M5: Hospital cost / Hospital day
- M6: Treatment cost / ED visit
- M8: No. of ED visits / 100 fatal injuries

Serious injuries

$$C2 = I2 \times [(M6 \times M7) + (M1 \times M5) + (M3 \times M4)]$$

- I2: No. of serious injuries (requiring a hospital admission)
- M6: Treatment cost / ED visit
- M7: No. of serious injuries admitted via an ED visit / 100 serious injuries
- M1: Transport cost / ED/hospital visit
- M5: No. of ED visits requiring transport / 100 serious injuries
- M3: Hospital days / Hospital admission
- M4: Hospital cost / Hospital day

Slight injuries

$$C3 = I3 \times [M6 + (M1 \times M5)]$$

- I3: No. of serious injuries (requiring ED visit)
- M6: Treatment cost / ED visit
- M1: Transport cost / ED visit requiring transport
- M5: No. of ED visits requiring transport / 100 slight injuries

- average age at death from violence-related injury (P1);
- average age at retirement/at which a person ceases to work (P2);
- the average number of days a victim of a serious injury is unable to resume her/his normal activities (at the hospital and recovering at home), keeping in mind that this may need to be adjusted depending on coping mechanisms (P3);
- the average number of days a victim of a slight injury is unable to resume her/his normal activities (recovering at home and during outpatient visits), keeping in mind that this may need to be adjusted depending on coping mechanisms (P4);
- average wage rate per capita per day (P5), derived from available age/sex-specific wage data or national wage rates; and
- a discounting factor, D (see below), based on a discount rate of 3%, which should be applied to discount future costs on the principle that people value income in the present more than they do an equivalent amount in the future.

The average number of years lost is calculated from the average age at death from violence-related injury (data to be obtained from hospital and mortuary records) and the average age at which a person ceases to work. Information on inactive days caused by slight or serious injuries can be obtained from hospital records, employers' records, insurance company records and case studies.[1] In the case of the informal workforce, the researcher may look to existing data from survey research or make an estimate based on survey data.

For calculating the average value of lost days and years, researchers should attempt to determine the age/sex-specific wage rates and multiply these by the time lost. In the absence of age/sex-specific wage data, the value of lost days can be calculated on the basis of national wage rates before tax, as published by national governments.

In the process of estimating loss of productivity, researchers should also be aware of the possible impact that coping mechanisms may have on costs. Coping mechanisms are strategies adopted to minimize the effects of disease, illness or injury on the welfare of those concerned (e.g. intra-household labour substitution) (*19*). Ignoring coping mechanisms to mitigate the loss of productivity due to injury may lead to an overestimate, and they are therefore important to consider (*19*).

Unemployment adjustments

Unemployment and underemployment are common features of many economies. The value of lost productivity should be adjusted according to unemployment, especially for countries with substantial unemployment. The unemployment rate, which is often readily available, is one value that can be used for unemployment adjustments. Information on employment status may also be obtained from local or regional survey research.

Informal and unpaid work adjustments

Wage rates are not an indicator of productivity, because our societal "productivity" goes beyond our wages (by voting, by raising children, by helping our neighbour, by volunteering, etc.). Informal and unpaid work is an important part of a country's real income, and the loss of these services should be taken into account when estimating the economic burden of violence-related injuries. Estimates of the value of the informal economy are available for a large number of countries.[2] Estimating the amount of unpaid work is more difficult.

---

[1] For estimating time lost due to disability, see van Beeck et al. (*18*). Such studies require victims to be interviewed several months after discharge from hospital. If time does not allow for a detailed assessment of time lost due to disability, physicians estimates at the time of hospital treatment may be gathered.

[2] See, for instance, Schneider (*20*), which provides informal income estimates (as a percentage of GDP) for 110 countries.

Unpaid work refers to productive activities that are not compensated by monetary payments. They take place outside the formal labour market, often in the home. Examples include cooking, cleaning, shopping, caring for family members and the sick, subsistence agriculture, building and maintaining houses, transport, and contributing to running family businesses. Important unpaid workers include housewives and self-employed agricultural workers, for which no income statistics exist.

The manual recommends integrating unpaid work into productivity loss estimates where time-use surveys are available. In time-use surveys, respondents are asked how much time they spend on a series of unpaid yet productive activities. To date, at least 82 countries have conducted at least one time-use survey (*21*). However, the researcher should keep in mind that unpaid work is not a component of market production. This is important if comparisons are to be made with GDP, in which case only the market component of productivity loss should be included.

If more detailed local information is unavailable, the researcher might estimate the number of days lost for unpaid work. For example, research in the United States found that household work was lost on 90% of days when paid work was lost (*22*). Because 90% may be high for many settings, the manual suggests a sensitivity analysis to examine the effect of different values for unpaid work on cost estimates. Information on occupational status may also be available from local or regional surveys and the distribution then applied to lost productivity calculations.

Informal and unpaid work can be included in lost productivity calculations by using the following basic formula when calculating average income per capita per day:

Avg. income = avg. formal income + avg. informal income + avg. value of unpaid work

where:

- average informal income per day = average formal income per day × the size of the informal economy (as a percentage of national GDP); and
- average value of unpaid work = average formal income per hour (adjusted for unskilled labour if possible) × average number of unpaid work in hours.

Again, it is important that the researcher removes the unpaid work component of productivity loss if comparisons are to be made with GDP.

For lost productivity associated with fatalities, the manual recommends using a standard discount rate of 3% per year. The concept of discounting is similar to the concept of compounding interest. A compound interest rate is used to calculate the future value (*FV*) of money (i.e. how much a sum of money earned today will be worth in the future). The discount rate is the reverse of this and is used to calculate the present value (*PV*) of a sum of money to be earned in the future. The equation for discounting a stream of future monetary values into PV values is as follows:

$$PV = \sum_{t=1}^{T} FV_t (1+r)^{-t}$$

or

$$PV = \frac{FV_1}{(1+r)^1} + \frac{FV_2}{(1+r)^2} + \ldots + \frac{FV_T}{(1+r)^T}$$

where:

- *PV* = present value of income
- *FV* = future value of income

- r = discount rate
- t = time unit (i.e. one year)
- T = total number of years considered (i.e. P2 – P1 + 1).

Since we assume that lost productivity resulting from violent fatalities will remain constant over time (i.e. that the same annual income will be applied to each year of productive life lost), the following equation can be used to discount future earnings (*23*).

$$PV = FV \left[\frac{1}{r} - \frac{1}{r(1+r)^T} \right]$$

Table 4 provides the basic equation for calculating loss of productivity.

Table 4. Loss of productivity: required data and basic costing equations

SEVERITY OF INJURY	REQUIRED DATA	BASIC COSTING EQUATION
Fatal (L1)	I1, P1, P2, P5, D	L1 = I1 × 365 × P5 × D × (P1 – P2) where D = 1 / 0.03 – 1 / [0.03 × (1.03)$^{P2-P1+1}$]
Serious (L2)	I2, P3, P5,a.	L2 = I2 × aP3 × P5
Slight (L3)	I3, P4, P5,a.	L3 = I3 × aP4 × P5

Note: a is an adjustment factor for coping mechanisms and/or unemployment (range 0–1). D is a standard discount rate of 3% per year.

4.2 Applying a modular approach: data and methods

Disaggregating minimum data requirements

The minimum requirements outlined above are useful for generating estimates capable of raising awareness among policy-makers and the general public of the overall magnitude of the costs of violence-related injuries. An aggregate figure of the costs of injuries due to interpersonal and self-directed violence can be a powerful advocacy tool, especially when medical costs are presented as the proportion of a country's public health budget or when compared to the costs of injuries due to other causes, such as road traffic accidents, burns or falls. Thus, comparing the costs of violence-related injuries with spending on violence prevention can influence policy-making and resource allocation.

Costing violence-related injuries, however, has more to offer than just one "big number". It can help policy-makers and practitioners set priorities by identifying specific areas where targeted interventions could be implemented. This can include determining which types of violence-related injury impose the highest costs on society, by distinguishing the various costs of injuries arising from youth violence, child maltreatment, intimate partner violence, sexual violence, workplace violence and self-directed violence.[1]

A useful starting point for determining how best to disaggregate cost estimates is to observe incidence data in greater detail. Provided demographic data are available, the distribution of injuries among predetermined age and gender groupings[2] can be cross-checked with the general distribution of the population derived from a national census. If the incidence of violence-related injury appears disproportionately high among certain demographic groups, such as young men for instance, it might be worth producing a cost estimate specifically for this group so as to attract the attention of policy-makers

[1] For a literature review of the costs of these different types of violence, see WHO (*1*).
[2] WHO uses the following age groups (*7*): 0–4 years, 5–14 years, 15–29 years, 30–44 years, 45–59 years and 60 years or more.

Table 5. ICD-10 codes for mechanisms of self-directed and interpersonal violence

CATEGORY	SELF-DIRECTED VIOLENCE	INTERPERSONAL VIOLENCE
Physical		
Poisoning	X60–X69	X85–X90
Hanging, strangulation and suffocation	X70	X91
Drowning and submersion	X71	X92
Firearm discharge:		
hand gun	X72	X93
rifle, shotgun or larger	X73	X94
unspecified	X74	X95
Explosive materials	X75	X96
Smoke, fire and flames	X76	X97
Steam, hot vapours and hot objects	X77	X98
Sharp objects	X78	X99
Blunt objects	X79	Y00
Jumping/pushing from a high place	X80	Y01
Jumping/lying before:		
moving object	X81	Y02
motor vehicle	X82	Y03
Other specified means	X83	Y08
Unspecified means	X84	Y09
Assault by bodily force		Y04
Sexual		
Sexual assault by bodily force		Y05
Deprivation/neglect		
Neglect and abandonment		Y06
Psychological		
Other maltreatment syndromes, including mental cruelty, physical abuse, sexual abuse and torture		Y07

to those most at risk. In general, the more disaggregated the incidence and costing data, the more useful and accurate the estimates will be.

Considering the costs associated with the different mechanisms involved in inflicting violence-related injuries can reveal additional intervention points. Table 5 provides the ICD-10 codes for mechanisms that may be more or less relevant depending on the local context. For instance, countries where a significant proportion of violence-related injuries involve the use of firearms may wish to compare the costs of injuries caused by firearms, sharp objects and other mechanisms. Studies in Canada and the United States, for instance, indicate that firearm-related violent injuries are more costly than those involving other mechanisms (*1*,*24*). Specific issues to explore include whether the type of mechanism used affects the severity of injury, the duration of hospitalization, and the demographic profile of the victims.

Disaggregating incidence data by injury group can generate more accurate cost estimates. Breaking down the types of treatment required by type of injury will shed further light on the types of violence-related injury that incur the highest costs. One useful injury grouping is offered in the Eurocost model (*25*), which identifies 39 injury groups that are then regrouped into ten broader categories (see Table 6).

Identifying and measuring quality of life

Quality of life is a concept used to convey a general sense of well-being, happiness, comfort and enjoyment. Many dimensions make up overall quality of life, including job opportunities, access to schools and public services, and participation in community

Table 6. Major injury groups in the Eurocost model

INJURY GROUP	ICD–10 CODES
Head and facial injury (excluding eye injury)	S06.0 S02.0–S02.1, S02.7, S02.9, S06.1–S06.9, S04.0–9, S07.1–S07.9, T02.0, T04.0 S01.0, S08.0 S02.2–S02.6, S02.8 S01.1–S01.9, S08.1–S08.9, S09.2
Eye injury	S01.1, S05.0–S05.9
Injuries to vertebral column, spine, internal organs, and rib/sternum fractures	S12.0–S12.7, S12.9, S13.0–S13.3, S13.6, S22.0–S22.1, S23.0–S23.1, S23.3, S29.0, S32.0–S32.2, S33.0–S33.2, S33.5–S33.7, T02.1, T03.0–T03.1, T08, T09.2 S13.4 S14.0–S14.1, S24.0–S24.1, S34.0–S34.1, S34.3, T06.1, T09.3 S26.0–S26.9, S27.0–S27.9, S29.7, S36.0–S36.9, S37.0–S37.9, S39.6–S39.9, T06.5 S22.2–S22.4, S22.8–S22.9
Upper extremity injury (excluding nerves)	S42.0–1, S42.7–S42.9 S42.2–S42.3 S42.4, S52.0–S52.4, S52.7–S52.9 S52.5–S52.6, S62.0–S62.1 S62.2–S62.8 S43.0–S43.7, S53.0–S53.4 S63.0–S63.7 S45–S49, S55–S59, S65–S69, T04.2, T05.0–T05.2, T11.4–T11.9
Lower extremity injury	S32.3–S32.8 S72.0–S72.2 S72.3, S72.7–S72.9 S72.4, S82.0–S82.2, S82.4, S82.7–S82.9 S82.3, S82.5–S82.6 S92.0–S92.9 S83.0–S83.7 S93.0–S93.9 S15.1, S75–S79, S85–S89, S95–S99, T04.3, T05.3–T05.5, T06.3, T13.4–T13.9, T14.5
Superficial injury, including contusions and open wounds	S00,S10, S20, S30, S40,S50, S60,S70, S80,S90, T00, T09.0,T11.0, T13.0,T14.0 S11, S21, S31, S41, S51, S61, S71, S81, S91, T01
Burns	T20–T32
Poisoning	T36–T65
Foreign body	T15–T19
Other and unspecified injury	S14.2–S14.4, S24.2, S44, S54, S64, T11.3 S73.0–S73.1 S34.2–S34.8, S74, S84, S94, T13.3 … and other codes

Source: Polinder et al. (*25*).

life. Aspects of quality of life that affect health are known as health-related quality of life (HRQOL). HRQOL refers to an individual's perception of his or her physical and mental health over time (*26*). Determinants of HRQOL at the individual level include health risks and conditions, functional status, social support and socioeconomic status. On the community level, they include resources, policies, and practices that affect a population's perception of health.

One way to measure HRQOL among victims of violence is to use the CDC's "Healthy

Days Measures". These comprise an integrated set of survey-administered questions about recently perceived health status and activity limitations, and provide estimates of the number of unhealthy days experienced by respondents over the previous 30 days.[1] According to a 1998 CDC study on HRQOL in eight American states, the 1.7% of adults who reported having current activity limitations due to a fracture or a bone or joint injury reported an average of 11.8 pain days (out of the past 30 days), compared to 1.1 pain days for adults who reported no activity limitation (*27*). HRQOL studies comparing the number of unhealthy days among victims of violence over time or with the general population can shed further light on the multifaceted effects of violence.

It is important to note, however, that despite its significance quality of life remains extremely difficult to measure, and even more difficult to value in economic terms. Efforts to measure quality of life among victims of violence should therefore proceed with caution and avoid attempting to assign a monetary value to losses in life quality.

4.3 Presenting findings to stakeholders

Once data have been collected and analysed, estimates of the costs of violence-related injuries must be presented and disseminated. This is usually done in the form of written reports geared to a target audience. Often, a single report will suit all intended readers but in some cases several reports, each containing various levels of detail, may be necessary to satisfy the requirements of all readers. A planner with a national health authority, for example, may appreciate more detail than a politician or a member of the general public. In any report, it will be particularly important to be transparent about the methods used and the categories of costs covered. Methodological decisions will need to be clearly stated to enable the audience to accurately interpret the results.

Costing injuries for the sake of costing injuries is a poor use of resources. The results of cost estimates are primarily intended to help planners respond to the problems of interpersonal and self-directed violence by developing new or improving existing policies and strategies on prevention and services for victims. Planners may include government officials responsible for resource allocation, specialists working for large agencies (such as the ministry of health) or generalists (including doctors, nurses and paramedics) working for smaller agencies. Members of the general public, who can endorse plans through their vote and seek amendments to policies by lodging complaints and suggestions, are another important audience.

While an academic audience may be interested in methodological approaches developed to overcome data limitations, policy-makers will be more responsive to "headline" findings that could include one or several of the following (provided the data support such assertions):

- Violence consumes XX% of the country's public health budget.
- A violent injury costs X times more than the average stay in hospital.
- Most of the costs of violence (XX%) are due to incidents among young people, who account for XX% of victims.
- The use of firearms in homicides dramatically increases the costs of violence by a ratio of X : 1. Reducing the use of such weapons in violence by XX% could trigger savings of X amount per year.

"Headlines" such as these will easily be picked up by the press and generate widespread public interest, and it is therefore useful to communicate results to policy-makers ahead of an official launch to enable them to prepare an appropriate response and to reflect on

[1] The questionnaire can be accessed online at http://www.cdc.gov/hrqol/hrqol14_measure.htm.

possible policies. This may be an effective way of influencing policy and increasing the allocation of resources to injury prevention.

4.4 Step-by-step recommendations for estimating the costs of violence-related injuries

Countries around the world are at very different stages with regard to their capacity for data collection and, even when available, the quality of the data may not be suitable for research (*7*). Agencies and institutions keep records for their own purposes, following their own internal procedures, which means that their data may be incomplete or lack the information necessary for a proper understanding of violence. Important information for researchers such as the circumstances of the incident – crucial to determining intent – is sometimes considered confidential. In a number of cases, only paper records will be available.[1]

The extent to which the necessary data are already available from existing sources or must be obtained through new studies will determine the practical steps involved in estimating the economic costs of violence. The two main categories of data required are incidence data (the number of violent injuries) and average unit costs. The estimated costs are arrived at by multiplying the number of incidents by the costs per case.

Obtaining incidence data

Fatal violence-related injuries

Data on violence-related fatalities must be obtained from a credible source such as the ministry responsible for vital statistics, from burden of disease estimates, or from surveys of the general population based on probability sampling. For fatal violence-related injuries, the absolute minimum incidence data required to produce an economic cost estimate are the total number of violence-related deaths available for the study area and the average age of the victims at death. As noted in Section 4.1, however, a more meaningful estimate will be produced when the data are disaggregated by intent and mechanism of injury, and by the age and sex of the deceased.

Non-fatal violence-related injuries

Data on the incidence of non-fatal violence-related injuries will generally be more difficult to obtain than those on violence-related deaths. Hospitals are likely to be the most readily accessible source of data, but will only reflect incidents leading to injuries that result in hospital treatment. The researcher should be aware that some types of violence may be underrepresented in hospital data. Box 1 describes an example from South Africa of a rapid assessment procedure for estimating the total number and incidence of violence-related injuries, irrespective of severity, seen in hospitals. The resulting estimates were not disaggregated by injury severity, type of violence, victim age, sex and mechanism; they would thus need to be multiplied by an average cost per violence-related hospital presentation that reflects the aggregate costs across all levels of severity, types of violence, victim age, sex and mechanism.

[1] A revealing illustration of the disparity in data collection capacities, even among high-income countries, can be found in the Eurocost project. The project sought to estimate the direct medical costs of injuries among ten western European countries. Neither Italy nor Spain could provide ED data on the incidence of home and leisure injury, while Greece did not have hospital admission figures. ED data on the incidence of intentional injuries were available in only four of the countries under study (*25*). Data are likely to be even scarcer in low- and middle-income countries.

BOX 1

Estimating the total number of violence-related injuries receiving hospital treatment: an example from South Africa

In many settings, scarce and incomplete public health data will make it necessary to estimate the number of violence-related injuries that receive hospital treatment in the area under study.

In South Africa, researchers used questionnaires completed by hospital medical superintendents to estimate the annual number of cases due to violence, road traffic accidents and other causes of injury treated in the country's hospitals. They concluded that approximately 750 000 violence-related injuries receive hospital treatment each year (out of a total of 1.5 million injury cases). This total reflects patients that received emergency department treatment only, those that were admitted and then discharged, and those that died in hospital.

The rapid assessment method involved sending questionnaires to medical superintendents at all 356 hospitals, requesting information about trauma caseloads and the distribution of injuries by cause. Some 75% of all hospitals responded, ranging from 45% in one of the country's nine provinces to 100% in another province. Of the hospitals that responded, 98% provided information on the total number of trauma cases seen per year, and 79% specified the proportion of injuries that were due to violence, traffic accidents and other injuries. Caseload data for non-responding hospitals were extrapolated at the provincial level by assuming that these hospitals averaged the same caseload as responding hospitals in each province.

The distribution of injuries due to traffic accidents, violence and other causes was also assumed to mirror the cumulative provincial proportions from responding hospitals. Injury rates were calculated from these estimates using the population figures from the national census, and a 95% confidence interval was calculated for the total injury rate in each province and the country as a whole.

Source: adapted from Matzopoulos et al. (*28*).

Obtaining costing data

In the majority of countries, even the minimum required costing data will probably not be available from an existing source. It will therefore be necessary to generate them by studying costs for violence-related injuries treated in a small sample of facilities. The costs calculated from these studies can then be multiplied by the total number of violence-related incidents to provide an estimate of the economic costs of non-fatal violence-related injury seen in the study area.

Step 1. Select sample facilities

The first step involves selecting one or more medical facilities that are believed to be generally representative of the area under study. A list of all operational facilities in the area, including bed capacity, level of care provided and administrative unit, should be obtained from the local health authority. Based on the distribution of facilities according to these three criteria, facilities will be selected for further study. The overall list of facilities will also be useful for extrapolating final results.

Step 2. Determine the study period

If the required incidence data are available from the facility's paper records, going through existing files will be sufficient. Should the availability and quality of paper records be insufficient to meet the minimum data requirements, it will be necessary to undertake a survey of patients.[1] In this case, it will be necessary to ensure that the study protocol is reviewed by an ethics committee, to obtain the patients' authorization to include them in the study, and to provide appropriate guarantees that information will be confidential. Questionnaires may be administered by hospital staff or by a trained team of researchers.

[1] See, for example, Paniagua et al. (*29*) for a study estimating the costs of gun violence in El Salvador, based on data collected from 100 hospital patients.

One sampling strategy involves capturing a minimum sample of patients (e.g. 100) to gather the missing information from each facility. The study period is then determined by the rate at which victims of self-directed and interpersonal violence visit the facility. This can be obtained by discussing the frequency of visits with facility personnel. If the facility treats an average of 100 violence-related injuries every two months, then the data should be collected and analysed for a two-month period. Some of the required information (e.g. length of stay) may require following the patients beyond that period, in which case it may be necessary to obtain estimates from the provider. Alternatively, researchers may choose to capture data for all patients receiving treatment at the selected facilities for a set period (e.g. one or two months), provided this is sufficient to collect information on at least 100 cases of violence-related injury.

Step 3. Gather incidence and costing data

Whether the source of information is hospital or facility registers or a new patient survey (for a template questionnaire, see Annex 1), the following minimum information should be collected for each individual treated at the facility for a violence-related injury:

- sex and age of the patient;
- employment status and occupation;
- hourly income/wage;
- injury intent (interpersonal, self-directed, undetermined) ;
- injury severity (ED only, hospitalization only, death);
- injury mechanism (firearm, sharp object, other);
- length of inpatient stay in days;
- whether the patient required transport to the ED, such as an ambulance;
- list of all operations carried out on the patient;
- list of all drugs given to the patient during and after the stay;
- the number of examinations (e.g. X-rays) carried out on the patient;
- the number of blood transfusions given to the patient;
- the number and type of physicians consulted during the stay;
- the estimated number of days the patient will be convalescing (i.e. not be able to work) after leaving the facility; and
- the estimated number of outpatient visits the patient will undertake after leaving the facility.

The last two items in the list above may be requested from the personnel treating the patient. If time allows, however, conducting follow-up interviews with patients after they leave the facility would be preferable and more accurate.

In addition to patient data, unit costs that should be gathered from the facility personnel (Annex 2) include:

- the average "hotel cost" per bed-day (i.e. the total budget of the facility minus drugs, operations and physicians divided by the number of beds);[1]
- the average cost of an ambulance or other transport to the ED;
- the costs of the various drugs used;
- the average cost per type of operation, examination and blood transfusion;
- the average cost per physician consultation; and
- the average cost per outpatient visit.

[1] As noted in section 4.1, the WHO-CHOICE econometric model for estimating country-specific hospital costs may serve as a useful reference point.

Step 4. Analyse the data at the facility level

Individual questionnaires should be entered into an electronic database so that results can be disaggregated using the breakdowns outlined in Section 4.1. For each case study facility, minimum cost estimates (medical and loss of productivity) should be produced for the 100 patients treated following the guidelines. Direct and indirect costs must be kept separate. Average unit costs should be derived for each victim of a slight (ED treatment), serious (hospital treatment) and fatal injury.

Step 5. Extrapolate results

Using the facility groupings established during step 1 and the known number of violence-related fatalities by administrative unit, case study results can be extrapolated at the administrative unit level as follows.

- Based on the ratio of slight, serious and fatal injuries found in the case studies and the known (or estimated) number of fatal violent injuries in each administrative unit, an estimate can be made of violent injuries (fatal and non-fatal) at the administrative unit level.
- Based on the above and average unit costs established in the case studies, an estimate can be made of the total annual cost of violence-related injuries at the administrative unit level.

All administrative unit estimates should be summed to generate an estimate of the overall cost of violence-related injuries in the area under study, keeping the direct and indirect costs separate. Table 7 provides an overview of the minimum data elements by severity of injury.

Table 7. Minimum data elements by severity of injury

DATA	SEVERITY OF INJURY		
	FATAL	SERIOUS	SLIGHT
Incidence			
Number of incidents by age, sex, mechanism and intent[a] (I1, I2, I3)	✔	✔	✔
Direct medical costs			
Average cost per medico-legal investigation of violence-related deaths (K1)	✔	—	—
Percentage of violence-related deaths subject to medico-legal investigation (K2)	✔	—	—
Average cost for transportation to ED or ambulance service per ED visit (M1)	✔	✔	✔
Percentage of fatal violent injuries that involved hospital admission (M2)	✔	—	—
Average length of stay in hospital (days) for injuries due to interpersonal or self-directed violence (M3)	✔	✔	✔
Average cost per bed-day of hospital treatment, including "hotel costs", physician fees, operations, blood transfusions, tests and examinations (e.g. X-rays) and drugs for violence-related cases (M4)	✔	✔	—
Percentage of injuries due to interpersonal or self-directed violence that required transportation or ambulance service (M5)	—	✔	✔
Average ED treatment cost per ED visit for violence-related cases (M6)	✔	✔	✔
Percentage of injuries due to interpersonal or self-directed violence admitted to hospital via ED (M7)	—	✔	—
Indirect medical costs			
Average age at death (P1)	✔	—	—
Average age at retirement (or ceasing to work) (P2)	✔	✔	✔
Average number of convalescent/rehabilitation days for a victim of serious injury (P3)	—	✔	—
Average number of convalescent/rehabilitation days for victims of slight injury (P4)	—	—	✔
Daily wage rates (paid and unpaid) (P5)	✔	✔	✔
Discount rate, 3% (D)	✔	✔	✔

[a] Disaggregating incidence data can generate more useful and accurate cost estimates.

5.
Estimating the economic costs of injuries due to interpersonal and self-directed violence in practice: case studies

5.1 Brazil

Estimating the economic costs of injuries due to interpersonal and self-directed violence in Brazil

AT Miranda Soares de Moura, G Loureiro Werneck, M de Sousa Nascimento

ISER – Institute for Religious Studies, State University of Rio de Janeiro, Federal University of Rio de Janeiro

KEY FINDINGS

- Direct medical costs in 2004 totalled 47 million Brazilian reais (R$) for injuries from self-directed violence and R$472 million for interpersonal violence.
- The average direct medical cost per incident in 2004 was R$687 for fatal violent injuries and R$3772 for serious injuries.
- Indirect medical costs for injuries due to self-directed violence in 2004 totalled R$1.8 billion and those for interpersonal violence R$13.7 billion.
- During 2004, the direct medical cost of injuries due to violence (R$519 million) accounted for about 0.4% of Brazil's total health expenditure while loss of productivity due to violence-related injuries (R$15.5 billion) accounted for approximately 12% of total health expenditure or 1.2% of GDP.[a]

[a] Evans and colleagues advise that only the indirect cost component involving market production (e.g. formal labour force) should be expressed as a percentage of GDP, and otherwise advise against such comparisons. In the absence of a suggested alternative, however, readers will undoubtedly make comparisons to GDP and the information is thus provided here with this note of caution.

Source: DB Evans et al., unpublished data, 2007.

Background

Brazil, the largest and most populous country in South America, is known as having one of the highest homicide rates in the world (*30*). Homicide is the leading cause of death for persons aged 15–44 years in Brazil (*31*). Homicide rates for all ages more than doubled between 1980 and 2002 from 11.4 to 28.4 per 100 000 population (*31*), although firearm-related hospital admissions and mortality have recently shown some decline (*30*). Suicide rates in Brazil are among the lowest in the world, although slight increases were observed between 1980 and 2000 (*32*). Estimated death rates per 100 000 population in Brazil during 2002 were 32.6 for interpersonal violence and 5.0 for self-directed injuries (*33*).

While our understanding of the burden of violence in Brazil is improving, the economic costs of injury from interpersonal and self-directed violence in the country remain largely unknown. This case study describes the estimated costs of injuries from interpersonal and self-directed violence occurring in Brazil in 2004.

Methods and results

Economic costs of injuries from interpersonal and self-directed violence were estimated using a draft version of this manual. Self-directed violence was defined as an act of violence that is inflicted upon oneself. Interpersonal violence was defined as an act of violence inflicted by another individual or by a small group of individuals. Violent injuries were categorized based on the severity of the injury into one of three groups. A *fatal* injury was defined as one in which the patient died as a result of the incident, provided death occurred within 30 days. A *serious* injury was defined as one that did not cause the patient's death within 30 days but was serious enough for the victim to be admitted to hospital as an inpatient. A *slight* injury was defined as one that required an ED visit but was not followed by hospital admission.

Incidence data

Incidence data were derived from violent acts occurring during 2004 and identified using existing national data. Violence-related injuries were classified using ICD-10 codes (*17*) (self-directed: codes X60–X84; interpersonal: codes X85–Y09) and were stratified by age, sex, intent (self-directed, interpersonal, unknown), mechanism (firearm, other) and type of injury (fatal, serious, slight). Mechanism (firearm vs other) was also defined using ICD-10 codes.

Data on the incidence of fatal injury were derived from the national mortality information system (Sistema de Informação de Mortalidade, SIM) (Table 8). Violence-related injuries are limited here to suicide, homicide (homicide plus legal intervention) and unknown intent, since these are the codes for which it is possible to obtain ancillary costing data at national level. According to the Global Burden of Disease Study (*34*), reporting of death is very close to 100%. Readers should be aware, however, that undefined or unknown causes are the fourth largest cause of death in Brazil, accounting for 13% of deaths in 2002.

The incidence of nonfatal violence-related injuries that required hospital treatment was estimated using health utilization information from the national hospitalization information system (Sistema de Informação de Internação Hospitalar, SIH) (Table 8). SIH data coverage is limited, as it only records hospital admissions within the public health care system network (Sistema Único de Saúde, SUS), which covers between 77.5% and 83.5% of hospital admissions in the country (*35*).

The incidence of slight injuries was estimated using data from the national outpatient care information system (Sistema de Informações Ambulatoriais, SIA) and a study conducted in two Rio de Janeiro emergency departments. Although the Ministry of Health launched a sentinel injury surveillance system in the emergency departments of 39 Brazilian cities in 2006, data were not available for this case study.

Costing data and estimation

All costing data are expressed in Brazilian reais (R$). A lifetime approach was employed to estimate the economic cost of injury, based on the incidence data described above and disaggregated national unit costing data. Direct medical costing data were derived from health service utilization and costs during 2004. Hospital and outpatient unit costs were derived from several sources, including the Ministry of Health and the Small Arms Survey. Direct medical costs are presented by severity and calculated using the equations shown in Table 8. The average cost per medico-legal investigation of violence-related deaths (not shown) was estimated at between R$996.85 and R$1155.40. Based on data from Rio de Janeiro, it is estimated that 47% of firearm-related deaths are submitted for medico-legal investigation (*38*).

Table 8. Information and formulas used in economic costing calculations

PARAMETER	ESTIMATE	SOURCE/FORMULA
Fatal injury (I1)	See Table 9	2004 national mortality information system = (reported deaths from self-directed and interpersonal violence)
Serious injury (I2)	See Table 9	2004 national hospitalization information system = (injured inpatient admissions)
Slight injury (I3)	Data not shown	Estimated from multiple sources
Direct medical costs	See Table 10	Multiple sources **Fatal/serious injury** = {(fatal incidence × (percentage of fatal violent injuries that involve hospital admission) + (serious injury incidence)) × (average cost per bed-day of hospital treatment) × (average length of stay in hospital)} Percentages of fatal violent injuries involving hospital admission — Aggression 5.5% — Suicide 3.5% — Unknown 1.1% Average length of stay in hospital — 3.1 days (Small Arms Survey) — 5.2 days (36) — 6 days (aggression, Ministry of Health) — 3.9 days (attempted suicide, Ministry of Health) Average cost per bed-day of hospital treatment — R$749.78 (federal funds only, Small Arms Survey) — R$663,75 (aggression, Ministry of Health) — R$321,62 (attempted suicide, Ministry of Health) — R$328.78 (violent injuries) (36) **Slight Injury** = {slight injury incidence × average treatment cost per ED visit} Average treatment cost per ED visit — R$31.27 (federal funds only, Small Arms Survey) — R$ 250.20 (private care, Brazilian Medical Association)
Costs due to loss of productivity	See Table 11	**Fatal injury** = {I1 fatal injuries × 365 × P5 × D1 × (P1–P2)} **Serious injury** = {I2 × P3 × P5} **Slight injury** = {I3 × P4 × P5}
Average age at death from violent injury (P1)	Aggression/homicide: 30.12 years Self-inflicted: 39.56 years Unknown intent: 44.17 years	2004 national mortality information system
Average age at retirement / at which a person ceases to work (P2)	Men 55 years, women 51 years Public sector: men 57 years, women 54 years	Formal national retirement age, 2002

Continued on page 28

Table 8. Continued

PARAMETER	ESTIMATE	SOURCE/FORMULA
Average number of days a victim of a serious injury is unable to resume her/his normal activities (at the hospital and recovering at home) (P3)	By type of violence, sex, and age (values not shown)	Global Burden of Disease Study, Brazil
Average number of days a victim of a slight injury is unable to resume her/his normal activities (recovering at home and during outpatient visits) (P4)	5.7 days	Small Arms Survey Study in Rio de Janeiro (37)
Average daily per capita loss of income, derived from average income loss that incorporate paid and unpaid work as described above (P5)	R$1110.26 per month (varies by region)	Brazilian Census, 2000
Discount factor (D)	3%	$D = 1 / 0.03 - 1 / [0.03 \times (1.03)^{P2-P1+1}]$

Indirect costs for fatal, serious and slight injuries were estimated using a human capital approach, by measuring the value of time lost due to absence from work or reduced productivity using the formulas shown in Table 8. Future earnings were discounted at a rate of 3%. Age at death from violent injury was obtained from vital registry data. Average age at retirement was 55 years for men and 51 years for women. Inactive days caused by serious injury were derived from the average duration of injuries by body part provided by the Global Burden of Disease Study (*34*) and inactive days caused by slight injury were derived from a Small Arms Survey study in Rio de Janeiro (*37*). Based on data from the Brazilian Census of 2000, which reported an average weekly wage of R$1110.26, the average daily loss of income due to violence-related injury was estimated at R$37.

Age/sex-specific frequencies of injury are displayed in Table 9 by severity and type of injury. An estimated 18 201 injuries from self-directed violence (44% fatal, 56% serious) and 97 209 injuries from interpersonal violence (50% fatal, 50% serious) were identified for 2004. An estimated 27 424 fatal violence-related injuries were firearm-related (Table 10). A total of 14 383 (13 127 men, 1256 women) hospital admissions for firearm-related injuries were identified for 2004.

As noted above, information on slight injuries was not directly available. Based on data from the Ministry of Health and a Small Arms Survey study, the estimated number of slight injuries due to violence is 400 000 for interpersonal violence and 80 000 for attempted suicide. These estimates are derived from the number of hospital admissions for 2004 from the SIH and three assumptions:

- that about 70% of all serious injuries admitted to hospital are due to violence;
- that 80% of unknown intent cases are due either to interpersonal or to self-directed violence; and
- that the cases of unknown intent that are likely to be due to interpersonal or self-directed violence can be attributed to each category based on the ratio of hospital admissions in each category.

A second estimate, based on data from SIA and a study of two Rio de Janeiro emergency departments (*39*), would suggest that the number of slight injuries due to interpersonal and self-directed violence may be as high as 9.6 million and 960 000, respectively.

Table 9. Number of violent injuries by age, sex, and severity and type of injury, Brazil 2004

AGE GROUP (YEARS)	FATAL INJURIES			SERIOUS INJURIES		
	SELF-DIRECTED	INTERPERSONAL	UNKNOWN	SELF-DIRECTED	INTERPERSONAL	UNKNOWN
Men						
0–4	0	86	177	182	713	1145
5–14	48	472	232	378	1 976	3 063
15–19	439	7 346	650	460	5 316	1 937
20–29	1 590	18 992	1 975	1 506	13 563	5 084
30–39	1 357	9 575	1 720	1 475	8 003	3 820
40–49	1 144	4 958	1 558	1 107	4 838	2 799
50–59	804	2 218	1 045	635	2 650	1 669
60–69	495	942	700	279	1 336	901
70–79	307	384	545	114	721	560
≥ 80	129	119	454	52	385	309
All ages	**6 313**	**45 092**	**9 056**	**6 188**	**39 501**	**21 287**
Women						
0–4	3	59	150	131	490	773
5–14	59	183	113	289	922	1 386
15–19	202	539	104	601	836	726
20–29	361	1 223	261	969	1 865	1 384
30–39	362	819	242	771	1 429	1 174
40–49	319	559	250	619	1 110	1 023
50–59	192	232	188	299	713	865
60–69	108	113	215	151	524	668
70–79	79	79	337	97	494	594
≥ 80	21	32	748	67	395	439
All ages	**1 706**	**3 838**	**2 608**	**3 994**	**8 778**	**9 032**
Total	**8 019**	**48 930**	**11 664**	**10 182**	**48 279**	**30 319**

Table 10.Number of deaths from violent injuries disaggregated by mechanism

AGE GROUP (YEARS)	FIREARMS			OTHER MECHANISMS		
	MALE	FEMALE	TOTAL	MALE	FEMALE	TOTAL
0–4	176	155	331	18	15	33
5–14	306	229	535	365	105	470
15–19	1 434	516	1 950	6 257	395	6 652
20–29	4 839	1 003	5 842	15 606	785	16 391
30–39	4 363	982	5 345	7 110	508	7 618
40–49	3 871	892	4 763	3 394	308	3 702
50–59	2 703	574	3 277	1 444	112	1 556
60–69	1 738	430	2 168	625	46	671
70–79	1 209	494	1 703	239	23	262
≥ 80	730	780	1 510	64	7	71
Total	**21 369**	**6 054**	**27 424**	**35 122**	**2 305**	**37 427**

Note: the number of deaths presented in this table does not match exactly the total number of violent deaths in 2004 because some deaths cannot be specified at the level of mechanism.

These are likely to be overestimates, however, as they were based on data from only two trauma centres in Rio de Janeiro where levels of violence are probably higher than in many other parts of the country.

Direct medical costs for injuries due to fatal or serious self-directed and interpersonal violence totalled R$382 million (Table 11). The direct medical costs for slight injuries due to interpersonal violence totalled R$120 million (men R$90 million, women R$30 million) and those for injuries due to self-directed violence were R$17.5 million (men R$7 million, women R$10.5 million). Nearly 75% of direct medical costs were attributable to injuries among men. The average direct medical cost (per incident) was R$687 for fatal injuries, R$3772 for serious injuries and R$286 for slight injuries (Table 12).

Table 11. Direct medical costs[a] by age, sex, severity and type of injury, Brazil 2004

AGE GROUP (YEARS)	FATAL INJURIES		SERIOUS INJURIES	
	SELF-DIRECTED	INTERPERSONAL	SELF-DIRECTED	INTERPERSONAL
Men				
0–4	0	163 351	627 972	6 910 328
5–14	37 113	468 762	1 281 208	19 472 388
15–19	266 641	5 774 779	905 004	30 397 504
20–29	976 103	15 063 298	2 967 404	77 672 599
30–39	876 602	7 925 657	3 049 005	48 081 637
40–49	797 747	4 377 876	2 398 846	30 470 597
50–59	598 968	2 071 614	1 410 883	17 112 888
60–69	405 663	954 889	640 382	8 912 538
70–79	300 512	454 548	280 601	5 157 982
≥ 80	197 238	210 769	130 785	2 814 329
All ages	**4 456 587**	**37 465 543**	**13 692 090**	**247 002 790**
Women				
0–4	4 658	124 965	444 431	4 677 536
5–14	44 167	187 234	885 779	8 546 158
15–19	128 757	440 993	1 332 818	5 388 437
20–29	234 686	1 017 460	2 124 844	11 886 182
30–39	243 018	699 891	1 742 101	9 384 506
40–49	227 572	502 862	1 451 579	7 565 423
50–59	153 070	229 454	817 055	5 662 785
60–69	116 245	145 492	442 635	4 464 372
70–79	133 331	153 386	286 549	4 241 453
≥ 80	167 578	278 277	192 510	3 298 654
All ages	**1 384 450**	**3 853 564**	**10 045 737**	**64 169 646**
Total	**5 841 037**	**41 319 107**	**23 737 827**	**311 172 436**

[a] In Brazilian reais.

Note: amounts may not add up exactly owing to rounding.

Table 12. Economic cost[a] per incident injury due to violence, Brazil 2004

TYPE OF INJURY	MEN	WOMEN	TOTAL
Direct medical costs			
Fatal injury	693	643	687
Serious injury	3 892	3 404	3 772
Slight injury	292	273	286
Loss of productivity			
Fatal injury	217 492	159 680	210 623
Serious injury	8 986	15 827	10 666
Slight injury	211	211	211

[a] In Brazilian reais.

Loss of productivity from injuries due to fatal or serious self-directed and interpersonal violence totalled R$15.4 billion (Table 13), while those due to slight injuries were estimated at R$101 million (data not shown). The total indirect medical costs for injuries due to self-directed violence were R$1.8 billion, while those for injuries due to interpersonal violence were R$13.7 billion. During 2004, estimated indirect costs per incident of violence-related injury ranged from R$211 for slight injuries to more than R$215 000 for fatal injuries among men (Table 12).

Violence-related injury costs in perspective

During 2004, total expenditure on health in Brazil was approximately US$60 billion, or about 10% of GDP (US$603.8 billion or about R$1.268 trillion). The direct medi-

Table 13. Loss of productivity[a] by age, sex, and severity and type of injury, Brazil 2004

AGE GROUP (YEARS)	FATAL INJURIES		SERIOUS INJURIES	
	SELF-DIRECTED	INTERPERSONAL	SELF-DIRECTED	INTERPERSONAL
Men				
0–4	0	44 211 283	6 0478 432	198 791 079
5–14	10 876 874	141 861 538	3 405 775	49 130 027
15–19	80 931 304	1 849 548 063	1 576 167	34 512 642
20–29	295 754 990	4 813 178 150	5 168 071	88 187 722
30–39	263 478 997	2 504 679 280	5 869 154	66 722 100
40–49	237 013 530	1 361 477 237	4 177 862	29 790 681
50–59	176 234 964	635 723 521	2 457 212	16 731 034
60–69	117 795 914	287 681 138	3 111 091	17 708 416
70–79	85 356 348	132 655 163	4 192 516	2 114 759
≥ 80	53 721 054	57 579 903	683 330	7 011 966
All ages	**1 321 163 975**	**11 828 595 276**	**91 119 610**	**510 700 426**
Women				
0–4	944 972	26 071 366	7 210 889	165 617 218
5–14	10 105 479	47 810 709	5 764 766	34 230 432
15–19	30 615 690	122 594 137	5 986 388	9 176 866
20–29	55 534 188	280 946 180	9 543 797	20 242 955
30–39	57 039 476	191 197 328	7 824 695	11 838 841
40–49	52 632 568	134 650 206	3 193 375	17 656 423
50–59	34 511 864	59 307 053	1 797 466	13 215 987
60–69	24 731 378	34 451 304	1 744 666	11 686 278
70–79	26 614 495	32 609 375	2 180 094	4 815 650
≥ 80	30 474 959	48 866 339	1 270 529	10 091 279
All ages	**323 205 069**	**978 503 997**	**46 516 665**	**298 571 929**
Total	**1 644 369 044**	**12 807 099 273**	**137 636 275**	**809 272 355**

[a] In Brazilian reais.

cal cost (R$519 million) of injuries due to violence accounted for about 0.4% of the total health budget, while loss of productivity due to violence-related injuries accounted for approximately R$15.5 billion or 12% of the total health expenditure and 1.2% of GDP. By way of comparison, the annual costs of road accidents in Latin America and the Caribbean (including Brazil) are estimated to be about 1% of GNP (*40*).

Comment

Using the draft manual, this study estimates the economic costs of injury due to self-directed and interpersonal violence in Brazil. These cost estimates are almost certainly underestimates owing to incomplete reporting systems, the unseen nature of interpersonal violence and limitations in costing data (e.g. costs derived from SIH data refer to funds distributed to hospitals by the Ministry of Health but not private sources). Also, the burden of injuries due to firearm-related violence may underestimate the magnitude of the problem, as data from the national report on firearms violence in Brazil (*41*) suggests that 15% of all homicides were committed with an unknown weapon.

Several data sources, including vital statistics, hospitalization data and independent research studies, were used in completing the study. The availability of accurate, reliable and representative data from information systems, particularly health-related systems, is critical in providing useful information on the burden of violence and injury to decision-makers at local, regional and national levels. As health ministries take the lead in violence and injury prevention (*42*), data collection and information systems must play a central role.

5.2 Jamaica

Estimating the economic costs of injuries due to interpersonal violence in Jamaica

E Ward, A Grant

Jamaica Ministry of Health, Health Promotion and Protection Division and Jamaica Violence Prevention Alliance, Kingston

KEY FINDINGS

- Direct medical costs in 2006 totalled 2.1 billion Jamaican dollars (J$) for injuries from interpersonal violence.
- The average direct medical cost per incident in 2006 was J$72 000 for fatal injuries, J$418 000 for serious injuries and J$256 000 for slight injuries.
- Indirect medical costs for injuries due to interpersonal violence in 2006 totalled J$27.5 billion.
- During 2006, the direct medical cost of injuries due to interpersonal violence accounted for about 12% of Jamaica's total health expenditure (J$16.8 billion) while loss of productivity due to interpersonal violence-related injuries accounted for approximately 160% of total health expenditure or 4% of GDP.[a]

[a] Evans and colleagues advise that only the indirect cost component involving market production (e.g. formal labour force) should be expressed as a percentage of GDP, and otherwise advise against such comparisons. In the absence of a suggested alternative, however, readers will undoubtedly make comparisons to GDP and the information is thus provided here with this note of caution.

Source: DB Evans et al., unpublished data, 2007.

Background

Violence-related injuries are a major cause of morbidity and mortality in Jamaica. In recent years, homicide has increasingly contributed to the burden of violence in the island (*43*). In 1970, the homicide rate was 8.1 per 100 000 population; in 2002, it had risen to 40 per 100 000 (*44*) and in 2005 there were 1674 homicides, giving a rate of 62 per 100 000 (*45*).

In response to sharp increases in homicide rates and recognition of the impact that violence-related injuries have on the health system, Jamaica introduced a Violence-related Injury Surveillance System at the accident and emergency unit of Kingston Public Hospital. This system was subsequently replaced by the Jamaican Injury Surveillance System (JISS) at Kingston Public Hospital and four other hospitals on the island (*46–48*). While understanding of the burden of violence-related injuries in Jamaica is improving, thanks in part to the implementation of these surveillance systems, the economic costs of injury from interpersonal and self-directed violence in the country remain largely unknown. This case study describes the estimated costs of injuries from interpersonal violence occurring in Jamaica in 2006.

Methods and results

Economic costs of injuries from interpersonal and self-directed violence were estimated using a draft version of this manual. Self-directed violence was defined as an act of violence that is inflicted upon oneself. Interpersonal violence was defined as an act of violence inflicted by another individual or by a small group of individuals. Violent injuries were categorized based on the severity of the injury into one of three groups. A fatal injury was defined as one in which the patient died as a result of the incident, provided death occurred within 30 days. A serious injury was defined as one that did not cause the patient's death within 30 days but was serious enough for the victim to be admitted to hospital as an inpatient. A slight injury was defined as one that required an ED visit but was not followed by hospital admission.

Incidence data

Incidence data were derived from violent acts occurring during 2006. Violence-related injuries were classified using ICD-10 codes (*17*) (self-directed: codes X60–X84; interpersonal: codes X85–Y09) and were stratified by age, sex, intent (self-directed, interpersonal, unknown), type of injury (fatal, serious, slight) and mechanism (firearm, sharp object, other).

Data on the incidence of fatal injury were obtained from the Jamaica Constabulary Force (Table 14). The incidence of non-fatal violence-related injuries that required hospital treatment was estimated using data obtained from patients treated at and/or admitted to three Type A government hospitals (Kingston Public Hospital, Cornwall Regional Hospital and Bustamante Hospital for Children) between April and August 2006. These three referral hospitals are located in large urban areas; they provide the most complex mix of services available and generally reflect the full range of injuries seen at Jamaican government hospitals, which provide approximately 97% of all hospital care on the island. The incidence of slight injuries was estimated using data from accident and emergency (A&E) departments, as identified through hospital medical records.

Non-fatal violence-related injury data were collected from patient medical records using a data abstraction form designed by WHO and modified by a working group (comprising representatives of the Kingston Public and Cornwall Regional Hospitals) to reflect the options of the JISS, which captures violence-related injuries from the A&E departments of nine major government hospitals on the island (*47*).

Information on the type and mechanism of injury, the location of the incident and the relationship between the perpetrator and the victim were obtained from the JISS forms included in the patients' records. In addition, a trauma resuscitation flowsheet developed by A&E department staff was used to obtain information on vital signs, fluid administration, medications administered, and procedures and investigations carried out. Information on referrals and mode of transportation to the hospital was also obtained from the A&E record. All remaining information was abstracted from the admission face sheet and doctors' and nurses' notes.

Patients seen at A&E departments and/or admitted to hospital during the study period were selected from a line listing generated by the medical records department of each hospital. For patients who were admitted, research assistants visited the wards to interview victims of violence. Demographic data were obtained from the patients' dockets. Documentation for each completed form was retained for verification purposes, and at the end of each day all completed forms were cross-checked and validated by the research assistants. Validation was also carried out on a 10% sample of patient records.

Costing data and estimation

All costing data are expressed in Jamaican dollars (J$). A lifetime approach was employed to estimate the economic cost of injury, based on the incidence data described above and disaggregated hospital unit costing data. Direct medical costing data were derived from health service utilization and costs during 2006. Hospital unit costs were obtained from each of the participating hospitals. Cost calculations reflect charge data obtained from the university hospital and from a private hospital that operates on a cost recovery basis, rather than from the highly subsidized government hospital.

Costs varied according to the investigation and specific treatment required, as documented in the medical record. Investigation and treatment costs included staff costs, tests, intravenous fluids, dressings, drugs and costs of operations. All cases are eligible for medico-legal or coroner's investigation. The average cost per medico-legal investigation of violence-related death was estimated at J$70 800.

Indirect costs for fatal, serious and slight injuries were estimated using a human capi-

Table 14. Information and formulas used in economic costing calculations

PARAMETER	ESTIMATE	SOURCE/FORMULA
Fatal injury (I1)	See Table 15	Jamaica Constabulary Force = (reported deaths from self-directed and interpersonal violence)
Serious injury (I2)	See Table 15	Cases from 3 Type A government hospitals = (injured inpatient admissions)
Slight injury (I3)	Data not shown	Cases from A&E departments at 3 Type A government hospitals = (injured ED visits)
Direct medical costs	See Table 16	Multiple sources **Fatal injury** = fatal incidence × {(average cost per medico-legal investigation) × (percentage of fatal injuries that obtain medico-legal investigation) + (transport cost/ED visit) × (percentage of fatal injuries that involve transport to ED) + (percentage of fatal injuries that involve hospital admission) × (average cost per bed-day of hospital treatment) × (average length of stay in hospital)} **Serious injury** = serious injury incidence × {(transport cost/ED visit) × (percentage of serious injuries that involve transport to ED) + (average cost per bed-day of hospital treatment) × (average length of stay in hospital) + (average ED treatment cost) × (percentage of serious injuries that include an ED visit)} **Slight injury** = slight injury incidence × {(average treatment cost per ED visit) + (transport cost/ED visit)} Percentage of fatal violent injuries that involve hospital admission = 15.8 Average length of stay in hospital = 1 day Average cost per bed-day of hospital treatment = JA$4000 Average treatment cost per ED visit = JA$2000 Average ED transport cost = JA$5000
Costs due to loss of productivity	See Table 16	**Fatal injury** = {I1 × 365 × P5 × D × (P1–P2)} **Serious injury** = {I2 × P3 × P5} **Slight injury** = {I3 × P4 × P5}
Average age at death from violent injury (P1)	27.2 years	Mortuary and hospital records
Average age at retirement / at which a person ceases to work (P2)	65 years	Formal national retirement age, 2006
Average number of days a victim of a serious injury is unable to resume her/his normal activities (at the hospital and recovering at home) (P3)	27.9 days	Patient records

Table 14. Continued

PARAMETER	ESTIMATE	SOURCE/FORMULA
Average number of days a victim of a slight injury is unable to resume her/his normal activities (recovering at home and during outpatient visits) (P4)	6.8 days	Patient records
Average daily per capita loss of income, derived from average income loss that incorporate paid and unpaid work as described above (P5)	JA$2077.60 (varies by region)	Derived from national wage rate
Discount factor (D)	3%	$D = 1 / 0.03 - 1 / [0.03 \times (1.03)^{P2-P1+1}]$

tal approach, by measuring the value of time lost due to absence from work or reduced productivity using the formulas shown in Table 14. Future earnings were discounted at a rate of 3%. Based on hospital and mortuary data, the average age at death from violent injury was 27 years. The average age at which persons cease to work (i.e. retirement) was 65 years. The numbers of inactive days caused by serious injury (average = 28 days) or slight injury (average = 7 days) were obtained from patient records. The average daily loss of income loss due to violence was estimated at J$2077.60.

Age/sex-specific frequencies of injuries due to interpersonal violence are displayed in Table 15. A total of 1340 homicides occurred in Jamaica in 2006, a 20% reduction from the total for 2005. Three quarters of the homicides during 2006 were firearm-related and 15% involved a sharp object. Ninety percent of homicides occurred among men, and of these 39% occurred among those aged 18–29 years and 34% among those aged 30–44 years. The estimated number of serious injuries due to interpersonal violence during 2006 was 1160 (men 940, women 220); of these 27% involved a firearm and 44% involved a sharp object. Similarly, the estimated number of slight injuries due to interpersonal violence was 5968 (men 3188, women 2780); the majority of slight injuries among women involved pushing/shoving (n = 832) or use of a blunt object (n = 1128).

Direct medical costs totalled J$96.8 million for fatal injuries, J$484.8 million for serious injuries and J$1.5 billion for slight injuries due to interpersonal violence (Table 16). The estimated cost per incident of injury was approximately J$72 000 for fatal injuries, J$418 000 for serious injuries and J$256 000 for slight injuries. Direct medical costs for firearm-related injuries, which accounted for approximately 16% of all violence-related injuries during 2006, comprised 75% of total direct medical costs for fatal injuries, 53% of those for serious injuries and 6% of those for slight injuries.

Loss of productivity from injuries due to interpersonal violence totalled J$21.1 billion for fatal injuries, J$2 billion for serious injuries and J$4.3 billion for slight injuries (Table 16). The estimated cost per incident of injury was approximately J$15.8 million for fatal injuries, J$1.7 million for serious injuries and J$724 000 for slight injuries.

Interpersonal violence-related injury costs in perspective

During 2006, total expenditure on health in Jamaica was approximately J$16.8 billion, or about 2.5% of GDP. The direct medical cost (J$2.1 billion) of injuries due to violence accounted for about 12% of the total health budget, while loss of productivity due to interpersonal violence-related injuries accounted for approximately J$27.5 billion or 160% of the total health expenditure and 4% of GDP. By way of comparison, the annual costs of road accidents in Latin America and the Caribbean (including Jamaica) are estimated to be about 1% of GNP (*40*).

Table 15. Estimated number of fatal, serious and slight injuries due to interpersonal violence in Jamaica in 2006 by sex, age and mechanism[a]

INJURY AND MECHANISM	AGE GROUP (MEN) <18	18–29	30–44	>45	TOTAL	AGE GROUP (WOMEN) <18	18–29	30–44	>45	TOTAL
Fatal										
Total	129	469	409	181	1188	14	51	51	36	152
Firearm	80	396	320	123	919	9	29	30	21	89
Sharp object	37	62	69	42	210	3	14	16	8	41
Other	12	11	20	16	59	2	8	5	7	22
Serious										
Total	108	344	372	116	940	60	88	40	32	220
Firearm	28	140	80	4	252	4	20	16	16	56
Sharp object	52	148	180	52	432	28	36	8	12	84
Other	28	56	112	60	256	28	32	16	4	80
Slight										
Total	604	1 192	876	516	3 188	472	1 264	836	208	2 780
Firearm	16	48	28	4	96	0	0	0	0	0
Sharp object	196	592	332	100	1 220	120	264	128	32	544
Other	392	552	516	412	1 872	352	1 000	708	176	2 236

[a] Data on fatal injuries obtained from the Jamaica Constabulary Force. Data on serious and slight injuries obtained by sampling hospital records from three Type A government hospitals and multiplied by four to obtain annual estimates.

Table 16. Estimated direct medical costs and loss of productivity[a] for fatal, serious and slight injuries due to interpersonal violence in Jamaica in 2006, by mechanism

MECHANISM	FATAL INJURIES EVENTS	DIRECT	LOSS OF PRODUCTIVITY	SERIOUS INJURIES EVENTS	DIRECT	LOSS OF PRODUCTIVITY	SLIGHT INJURIES EVENTS	DIRECT	LOSS OF PRODUCTIVITY
Total	1 340	96 777	21 138 943	1 160	484 779	2 026 759	5 968	1 530 635	4 323 261
Firearm	1 008	72 800	10 438 765	308	258 071	1 745 422	96	99 258	671 316
Sharp object	251	18 128	16 147 461	516	119 090	171 349	1 764	175 800	252 944
Other	81	5 850	1 158 109	336	107 617	109 987	4 108	1 255 577	1 372 242

[a] Costs expressed in millions of Jamaican dollars.

Note: Amounts may not add up exactly owing to rounding.

Comment

Using the draft manual, this study estimates the economic costs of injury due to interpersonal violence in Jamaica. These cost estimates are almost certainly underestimates owing to incomplete reporting systems, the unseen nature of interpersonal violence and limitations in costing data (e.g. utilization information missing from patient medical records). Information on injuries due to self-directed violence was limited to those cases that were identified by patients' medical records, and our understanding of the burden of self-directed violence in Jamaica thus remains particularly weak.

Several data sources, including vital statistics, hospitalization data and the JISS were used in completing the study. The study used a sample of patient medical records from hospitals during a 3–4-month period to obtain utilization and cost information. This data collection process, although time- and resource-intensive, allowed for a detailed description of utilization patterns and costs.

The availability of accurate, reliable and representative data of the highest quality from information systems, particularly health-related systems, is critical in providing useful information on the burden of violence-related injury to decision-makers at local, regional and national levels. As health ministries take the lead in violence and injury prevention (*42*), data collection and information systems must play a central role.

5.3 Thailand

Estimating the economic costs of injuries due to interpersonal and self-directed violence in Thailand

K Bundhamcharoen, P Odton, S Mugem, S Phulkerd, K Dhisayathikom, V Tangcharoensatien

International Health Policy Program, Bangkok

KEY FINDINGS

- Direct medical costs in 2005 totalled 553 million Thai baht (THB) for injuries from self-directed violence and THB 1.3 billion for injuries from interpersonal violence.
- The average direct medical cost per incident in 2005 was between THB 9355 and THB 10 182 for fatal or serious violence-related injuries and THB 795 for slight injuries.
- Indirect medical costs for injuries due to self-directed violence in 2005 totalled THB 12.2 billion and those for interpersonal violence THB 14.4 billion.
- During 2005, the direct medical cost of violence-related injuries accounted for about 4% of Thailand's total health budget while loss of productivity due to violence-related injuries accounted for approximately 0.4% of GDP.[a]

[a] Evans and colleagues advise that only the indirect cost component involving market production (e.g. formal labour force) should be expressed as a percentage of GDP, and otherwise advise against such comparisons. In the absence of a suggested alternative, however, readers will undoubtedly make comparisons to GDP and the information is thus provided here with this note of caution.

Source: DB Evans et al., unpublished data, 2007.

Background

Violence is a public health problem in Thailand. Estimated death rates per 100 000 population in 2002 were 11.1 for self-directed violence and 9.4 for interpersonal violence (*33*). In the same period, the lifetime self-reported prevalence of physical and/or sexual violence against women aged 15–49 years approached 50% (*49*). Suicides per 100 000 population increased from 6.3 to 7.1 between 1988 and 2003, with a peak of 8.6 in 1999 (*50*).

While our understanding of the burden of violence in Thailand has improved, the economic costs of injury from interpersonal and self-directed violence in the country remain largely unknown. This case study describes the estimated costs of injuries from interpersonal and self-directed violence in Thailand in 2005.

Methods and results

Economic costs of injuries from interpersonal and self-directed violence were estimated using a draft version of this manual. Self-directed violence was defined as an act of violence that is inflicted upon oneself. Interpersonal violence was defined as an act of violence inflicted by another individual or by a small group of individuals. Violent injuries were categorized based on the severity of the injury into one of three groups. A *fatal* injury was defined as one in which the patient died as a result of the incident, provided death occurred within 30 days. A *serious* injury was defined as one that did not cause the patient's death within 30 days but was serious enough for the victim to be admitted to hospital as an inpatient. A *slight* injury was defined as one that required an ED visit but was not followed by hospital admission.

Incidence data

Incidence data were derived from violent acts occurring during 2005 and identified using existing national data. Violence-related injuries were classified using ICD-10 codes (*17*) (self-directed: codes X60–X84; interpersonal: codes X85–Y09) and were stratified by age and sex as well as by intent (self-directed, interpersonal), mechanism and type of injury.

Data on the incidence of fatal injury were derived from national vital registry data redistributed for unknown causes of death (Table 17). Vital registry data were compared with police data and other health reports. The incidence of non-fatal violence-related injuries was estimated using health utilization information from the 2005 National Health Security Office inpatient database and admission rate information from the 2005 National Health and Welfare Survey (Table 17). Utilization data reflect admissions to public hospitals under the jurisdiction of the Ministry of Public Health and account for approximately 70% of total admissions nationwide. Non-fatal incidence that did not require admission to hospital was derived from age/sex-specific ratios of outpatient to inpatient utilization from the 2003 National Health Examination Survey (Table 17). Information on the mechanism of violence was not available for cases not involving hospital admission but was assumed to be similar to that for cases involving hospital admission.[1]

Costing data and estimation

All costing data are expressed in Thai baht (THB). A lifetime approach was employed to estimate the economic cost of injury, based on the incidence data described above and disaggregated national unit costing data. Direct medical costing data were derived from health service utilization and costs during 2005. Hospital unit costs (THB 2537 per admission) were derived from reported national hospital costs for all causes, adjusted by average length of stay for violence-related hospital admissions and a weighting based on diagnosis-related group classifications for violence-related hospital admissions. Outpatient unit costs (THB 795 per visit) were also obtained from a national hospital report. Outpatient and inpatient unit costs were weighted similarly owing to the absence of appropriate data. Direct medical costs are presented for serious and slight injuries.

Indirect costs were estimated for fatal, serious and slight injuries using a human capital approach, by measuring the value of time lost due to absence from work or reduced productivity (Table 17). Future earnings were discounted at a rate of 3%. Age at death from violent injury was obtained from vital registry data. Average age at retirement was 60 years, based on the formal national age at retirement. Inactive days caused by slight injuries were derived from the average number of days with limited daily activity ascertained from a 2006 national health and welfare survey, and inactive days caused by serious injuries were derived from the average duration of injuries by body part provided by the Global Burden of Disease Study (*34*).

Average daily loss of income due to violence was estimated at THB 345. Average national wages before taxes were obtained from the 2006 National Labour Force Survey and incorporate formal and informal income. Days spent on unpaid productive activity were obtained from a national time use survey conducted in 2004. The unemployment rate, while known for the period (1.8%) (*51*), was not applied.

Age/sex-specific frequencies of injuries are displayed in Table 18 by severity and type of injury. An estimated 329 352 injuries due to self-directed violence (2% fatal, 16% serious, 82% slight) and 423 810 injuries due to interpersonal violence (2% fatal, 20%

[1] This assumption is likely to have led to an overestimate of the proportion of injuries inflicted by mechanisms that are more likely to cause severe injuries, such as firearms and sharp objects.

Table 17. Information and formulas used in economic costing calculations

PARAMETER	ESTIMATE	SOURCE/FORMULA
Fatal injury (I1)	See Table 18	2005 National Vital Registry = (reported deaths from self-directed and interpersonal violence) × (incomplete registration rate)
Serious injury (I2)	See Table 18	2005 National Health Security Office inpatient data and National Health and Welfare Survey = (injured inpatient admissions) × (utilization rates)
Slight injury (I3)	See Table 18	2005 National Health Security Office inpatient data and National Health and Welfare Survey = (serious injury) × (ratio of non-admission rate to admission rate)
Direct medical costs	See Table 18	2005 National Hospital Report **Fatal+serious injury** = {serious injury incidence × (inpatient unit cost adjusted by charge weights for cause of violence + outpatient unit cost adjusted by weights for cause of violence} **Slight injury** = {non-serious injury incidence × outpatient unit cost adjusted weights for causes of violence}
Costs due to loss of productivity	See Table 18	**Fatal injury** = {I1 fatal injuries × 365 × P5 × D1 × (P1–P2)} **Serious injury** = {(I2 short term injuries) × P3a × P5 } + {(I2 long term injuries) × 365 × P5 × D2} **Slight injury** = {I3 × P4 × P5}
Average age at death from violent injury (P1)	Men, self-inflicted: 41 years Men, interpersonal: 36 years Women, self-inflicted: 43 years Women, interpersonal: 39 years	2005 National Vital Registry
Average age at retirement / at which a person ceases to work (P2)	60 years	Formal National Retirement Age
Average number of days a victim of a serious injury is unable to resume her/his normal activities (at the hospital and recovering at home) (P3a)	By type of violence, sex, age and diagnosis-related group (values not shown)	Global Burden of Disease Study, Thailand 2004
Average number of years a victim of a serious injury is unable to resume her/his normal activities (at the hospital and recovering at home). For long term sequelae see D2 (P3b)	By type of violence, sex, age and diagnosis-related group (values not shown)	Global Burden of Disease Study, Thailand 2004
Average number of days a victim of a slight injury is unable to resume her/his normal activities (recovering at home and during outpatient visits) (P4)	5 days	2006 National Health and Welfare Study
Average daily per capita loss of income, derived from average income loss that incorporate paid and unpaid work as described above (P5)	THB 345	2006 National Labour Force Survey (second trimester)

Table 17. Continued

PARAMETER	ESTIMATE	SOURCE/FORMULA
Ratio of average number of unpaid work hours to average number of paid work hours	0.3	2004 National Time Use Survey
Discount factor (D)	3%	D1 = 1 / 0.03 1 / [0.03 × (1.03)$^{P2-P1+1}$] D2 = 1 / 0.03 1 / [0.03 × (1.03)^{P3b}]

serious, 78% slight) were identified for 2005. Poisoning was the most common form of serious self-directed injury for men and women (84% men, 95% women). Sharp/blunt objects (men 67%, women 43%) and assault by bodily force (men 15%, women 35%) were the most common mechanisms of serious interpersonal injury; firearms accounted for 10% (n = 8275) of serious interpersonal injury. Similar results were observed for slight self-directed and interpersonal injuries.

Direct medical costs for injuries due to self-directed and interpersonal violence totalled THB 1.9 billion (Table 18). This estimate assumes that fatal events were not subject to medical care, and it therefore probably underestimates the actual total direct medical cost. The total direct medical cost for serious and slight injuries from self-directed violence was THB 553 million, while that for interpersonal violence was THB 1.3 billion. Nearly 75% (THB 1.4 billion) of direct medical costs were attributable to injuries among males. The direct medical cost per incident for serious injuries due to interpersonal violence with a firearm was THB 27 856 (average THB 3751), being 2.3 times greater than the overall direct medical cost per incident for other serious injuries due to interpersonal violence (THB 12 245) (average THB 2539) (data not shown).

Costs due to loss of productivity from injuries due to self-directed and interpersonal violence totalled THB 26.6 billion (Table 18). Indirect costs for self-directed injuries totalled THB 12.2 billion and those for interpersonal injuries totalled THB 14.4 billion. More than 80% of lost productivity was attributable to injuries among males and (as might be expected) loss of productivity due to fatal injuries was notably greater than that for serious or slight injuries.

Violence-related injury costs in perspective

The direct medical cost of injuries due to violence accounted for about 4% of Thailand's total health budget in 2005 (some THB 50 billion). Loss of productivity due to violence-related injuries accounted for approximately 0.4% of GDP (THB 6.9 trillion) in 2005. During 2005, estimated economic costs per incident of violence-related injury ranged from THB 795 for direct medical costs for slight injuries to nearly THB 2 million for lost productivity associated with fatal self-directed injuries among men.

Comment

Using the draft manual, this study provides some of the first estimates of the economic costs of injury due to self-directed and interpersonal violence in Thailand. These cost estimates are almost certainly underestimates owing to incomplete reporting systems and the unseen nature of interpersonal and self-directed violence. Several data sources, including vital statistics, hospitalization data and national surveys of health, labour and welfare were used in completing the study. The availability of accurate, reliable and representative data from information systems, particularly health-related systems, is critical in providing useful information on the burden of violence and injury to deci-

Table 18. Incidence of violent injuries and associated direct medical costs and loss of productivity by age, sex, and severity and type of injury, Thailand, 2005

AGE GROUP (YEARS)	SELF-DIRECTED VIOLENCE								INTERPERSONAL VIOLENCE							
	INCIDENTS			DIRECT MEDICAL COSTS[a]		LOSS OF PRODUCTIVITY[b]			INCIDENTS			DIRECT MEDICAL COSTS[a]		LOSS OF PRODUCTIVITY[b]		
	FATAL	SERIOUS	SLIGHT	SERIOUS	SLIGHT	FATAL	SERIOUS	SLIGHT	FATAL	SERIOUS	SLIGHT	SERIOUS	SLIGHT	FATAL	SERIOUS	SLIGHT
Men																
0 4		188	633	577	503			1	8	151	508	2 463	404	28	7	1
5 14	40	240	808	1 085	643	128		1	59	1 271	4 279	11 873	3 404	188	40	10
15 29	1 477	10 641	40 030	76 817	31840	4 106	41	72	1 916	44 030	165 637	579 473	131 749	5 423	1 189	429
30 44	1 799	5 247	17 766	43 576	14131	3 798	15	32	1 646	19 602	66 372	258 409	52 792	3 420	457	170
45 59	1 005	2 000	5 722	21 841	4551	958	3	10	981	6 237	17 844	90 300	14 193	977	132	46
60 69	343	772	2 599	8 879	2067		1	4	206	1 158	3 899	14 635	3 101		17	10
70 79	256	358	1 205	3 681	959			1	69	345	1 162	4 619	924		4	2
≥80	71	101	340	769	270				2	49	165	462	131			
All ages	**4 991**	**19 547**	**69 104**	**156 939**	**54 966**	**8 990**	**60**	**121**	**4 887**	**72 843**	**259 865**	**952 759**	**206 699**	**10 036**	**1 846**	**668**
Women																
0 4		145	643	334	511			2	13	119	528	1 479	420	44	3	1
5 14	19	767	3 401	3 646	2 706	61	1	9	23	335	1 486	2 100	1 182	76	8	4
15 29	375	20 812	141 782	108 363	112 774	1 050	27	322	200	4 611	31 412	41 832	24 986	560	88	77
30 44	522	7 868	44 585	45 521	35 463	1 089	10	98	267	5 051	28 622	53 496	22 766	549	97	70
45 59	397	2 320	6 960	15 672	5 536	393	2	12	177	2 376	7 128	21 827	5 670	170	36	14
60 69	141	535	2 373	4 049	1 887		1	4	47	488	2 164	5 160	1 721		8	5
70 79	106	274	1 215	2 312	967			3	27	167	741	1 864	589		3	2
≥80	35	80	355	344	282			1	4	42	186	372	148			
All ages	**1 595**	**32 801**	**201 314**	**176 869**	**160 127**	**2 593**	**41**	**451**	**759**	**13 189**	**72 267**	**122 438**	**57 482**	**1 399**	**243**	**173**
Total	**6 586**	**52 348**	**270 418**	**337 597**	**215 092**	**11 583**	**101**	**572**	**5 645**	**86 032**	**332 132**	**1 053 491**	**264 180**	**11 435**	**2 089**	**841**

[a] Costs expressed in thousands of Thai baht.

[b] Costs expressed in millions of Thai baht.

Note: Amounts may not add up exactly owing to rounding.

sion-makers at local, regional and national levels. As health ministries take the lead in violence and injury prevention (*42*), data collection and information systems must play a central role.

6.
References

1. *The economic dimensions of interpersonal violence*. Geneva, World Health Organization, 2004.
2. Felitti VJ et al. Relationship of childhood abuse and household dysfunction to many of the leading causes of death in adults. The Adverse Childhood Experiences (ACE) Study. *American Journal of Preventive Medicine*, 1998, 14:245–258.
3. Anda RF et al. The enduring effects of abuse and related adverse experiences in childhood: a convergence of evidence from neurobiology and epidemiology. *European Archives of Psychiatry and Clinical Neuroscience*, 2006, 256:174–186.
4. Anda RF et al. Adverse childhood experiences and prescribed psychotropic medications in adulthood: a prospective study. *American Journal of Preventive Medicine*, 2007, 32:389–394.
5. Tang B et al. The influence of child abuse on the pattern of expenditures in women's adult health service utilization in Ontario, Canada. *Social Science and Medicine*, 2006, 63:1711–1719.
6. *Violence: a public health priority*. Geneva, World Health Organization, 1996 (document WHO/EHA/SPI.POA.2).
7. *World report on violence and health*. Geneva, World Health Organization, 2002.
8. Waters HR et al. The costs of interpersonal violence – an international review. *Health Policy*, 2005, 73:303–315.
9. Rice DP. Cost of illness studies: what is good about them? *Injury Prevention*, 2000, 6:177–179.
10. Fleurence R. An introduction to health economics. *Pharmaceutical Journal*, 2003, 271:679–681.
11. Finkler SA. The distinction between costs and charges. *Annals of Internal Medicine*, 1982, 96:102–109.
12. Kuchler F, Golan E. *Assigning values to life: comparing methods for valuing health risks*. Washington, DC, USDA Economic Research Service, 1999 (http://www.ers.usda.gov/publications/Aer784, accessed 21 January 2008).
13. *Costing road accidents in developing countries*. Crowthorne, Transport Research Laboratory, 1995 (Overseas Road Note 10).
14. Rice DP. Cost-of-illness studies: fact or fiction? *Lancet*, 1994, 344(14):19–20.
15. Byford, S, Torgerson, DJ, Raftery, J. Cost of illness studies. *British Medical Journal*, 2000, 320:1335.
16. Choi BK, Pak AW. A method for comparing and combining cost-of-illness studies: an example from cardiovascular disease. *Chronic Diseases in Canada*, 2002, 23:47–57.
17. *International statistical classification of diseases and related health problems, 10th revision*. Geneva, World Health Organization, 2003 (http://www.who.int/classifications/apps/icd/icd10online, accessed 21 January 2008).
18. van Beeck E et al. *Draft guidelines for the conduction of empirical studies into injury-related disability*. Amsterdam, EUROSAFE, 2005.

19. Chima RI, Goodman CA, Mills A. The economic impact of malaria in Africa: a critical review of the evidence. *Health Policy*, 2003, 63:17–36.
20. Schneider F. *Size and measurement of the informal economy in 110 countries around the world*. Paper presented at the Workshop of Australian National Tax Centre, ANU, Canberra, Australia, 17 July 2002 (http://rru.worldbank.org/Documents/PapersLinks/informal_economy.pdf, accessed 21 January 2008).
21. United Nations Economic and Social Commission for Asia and the Pacific and United Nations Development Programme. *Integrating unpaid work into national policies*. New York, United Nations, 2003 (http://www.unescap.org/publications/detail.asp?id=802, accessed 21 January 2008).
22. Finkelstein E, Corso P, Miller T. *The incidence and economic burden of injuries in the United States*. New York, Oxford University Press, 2006.
23. Corso PS, Haddix AC. Time preference. In: Haddix AC, Teutsch SM, Corso PS, eds. *Prevention effectiveness: a guide to decision analysis and economic evaluation*, 2nd ed. New York, Oxford University Press, 2003.
24. *Small arms survey 2004: rights at risk*. Oxford, Oxford University Press, 2004.
25. Polinder S et al. *Eurocost phase 2 : A surveillance based assessment of medical cost of injury in Europe: Phase 2: Final report*. Amsterdam, Consumer Safety Institute, 2004.
26. Centers for Disease Control and Prevention. *Measuring healthy days. Population assessment of health-related quality of life*. Atlanta, GA, US Department of Health and Human Services, 2000 (http://www.cdc.gov/hrqol/pdfs/mhd.pdf, accessed 10 January 2008).
27. Centers for Disease Control and Prevention. Health-related quality of life and activity limitation – eight states, 1995. *Morbidity and Mortality Weekly Report*, 1998, 47:134–140.
28. Matzopoulos RG et al. Estimating the South African trauma caseload. *International Journal of Injury Control and Safety Promotion*, 2006, 13:49–51.
29. Paniagua I et al. Wounds caused by firearms in El Salvador, 2003–2004: epidemiological issues. *Medicine, Conflict and Survival*, 2005, 21:191–198.
30. Marinho de Souza M de F. Reductions in firearm-related mortality and hospitalizations in Brazil after gun control. *Health Affairs (Millwood)*, 2007, 26:575–584.
31. Homicide trends and characteristics – Brazil, 1980–2002. *Morbidity and Mortality Weekly Report*, 2004, 53:169–171.
32. Mello-Santos C, Bertolote JM, Wang YP. Epidemiology of suicide in Brazil (1980–2000): characterization of age and gender rates of suicide. *Revista Brasileira de Psiquiatria*, 2005, 27:131–134.
33. *Mortality and burden of disease estimates for WHO Member States in 2002*. Geneva, World Health Organization, 2002 (www.who.int/healthinfo/bod, accessed 2 January 2007).
34. Murray CJ, Lopez AD, eds. *The global burden of disease: a comprehensive assessment of mortality and disability from diseases, injuries, and risk factors in 1990 and projected to 2020*. Cambridge, MA, Harvard University Press, 1996.
35. Iunes R. *The economic impact of violence on health care services: a case study of the city of São Paulo*. Washington, DC, Pan American Health Organization, 1994.
36. Iunes RF. Acidentes e violências. III – Impacto econômico das causas externas no Brasil: um esforço de mensuração [Accidents and acts of violence. III. Economic impact of external causes in Brazil: an attempt at measurement]. *Revista de Saude Publica*, 1997, 31(4, Suppl.):38–46.
37. *Report on emergency service and hospital admission in Rio de Janeiro. Background paper*. Geneva, Small Arms Survey, 2006.
38. Oliveira SF et al. Participação da radiologia nas perícias necroscópicas de baleados, realizadas no Instituto Médico-Legal do Rio de Janeiro [The role of radiology in autopsy in gunshot wound cases performed at the Medico-Legal Institute, Rio de Janeiro]. *Radiologia Brasileira*, 2005, 38:121–124.

39. Deslandes SF, Silva CMFP, Ugá MAD. O custo do atendimento emergencial às vítimas de violências em dois hospitais do Rio de Janeiro [The cost of emergency care for victims of violence at two hospitals in Rio de Janeiro]. *Cadernos de Saúde Pública*, 1998, 14:287–299.
40. Jacobs G, Aeron-Thomas A, Astrop A. *Estimating global road fatalities*. Crowthorne, Transport Research Laboratory, 2000 (TRL Report 445).
41. Peres MFT. *Firearm-related violence in Brazil – summary report*. São Paulo, Center for the Study of Violence, University of São Paulo, 2004.
42. *Preventing injuries and violence: a guide for ministries of health*. Geneva, World Health Organization, 2007.
43. *Seventh United Nations survey of crime trends and operations of criminal justice systems, covering the period 1998–2000*. Vienna, United Nations Office on Drugs and Crime, 2004 (http://www.unodc.org/pdf/crime/seventh_survey/7pct.pdf, accessed 22 January 2008).
44. Lemard G, Hemenway D. Violence in Jamaica: an analysis of homicides 1998–2002. *Injury Prevention*, 2006, 12:15–18.
45. Biswas S. *Jamaica struggles to fight crime*. Kingston, BBC Jamaica, 2007 (http://news.bbc.co.uk/2/hi/americas/6657203.stm, accessed 22 January 2008).
46. Zohoori N et al. Non-fatal violence-related injuries in Kingston, Jamaica: a preventable drain on resources. *Injury Control and Safety Promotion*, 2002, 9:255–262.
47. Hasbrouck LM et al. Surveillance of interpersonal violence in Kingston, Jamaica: an evaluation. *Injury Control and Safety Promotion*, 2002, 9:249–253.
48. Ward E et al. The establishment of a Jamaican all-injury surveillance system. *Injury Control and Safety Promotion*, 2002, 9:219–225.
49. Garcia-Moreno C et al. Prevalence of intimate partner violence: findings from the WHO multi-country study on women's health and domestic violence. *Lancet*, 2006, 368:1260–1269.
50. Lotrakul M. Suicide in Thailand during the period 1998–2003. *Psychiatry and Clinical Neurosciences*, 2006, 60:90–95.
51. *Thailand: key indicators*. Washington, DC, World Bank (www.worldbank.org/th, accessed 22 January 2008).

ANNEX 1

Sample questionnaire for patients treated for violence-related injuries

Basic data

Q1. ID: .....

Q2. Today's date: DD/MM/YY

Q3. Arrival date: DD/MM/YY

Q4. Length of stay (in days, estimated): .....

Q5. Injury severity:
- ☐ ED / urgent care only
- ☐ Hospitalization
- ☐ Death

Patient profile

Q6. Gender: ☐ Male ☐ Female

Q7. Birth date: DD/MM/YY

Q8. Address: .....

Q9. Education: ☐ ..... ☐ ..... ☐ ..... ☐ .....

Q10. Marital status: ☐ Married ☐ Single ☐ Other

Q11. Profession: .....

Injury specification

Q12. Intent: ☐ Interpersonal ☐ Self-directed ☐ Unintentional ☐ Undetermined

Q13. Mechanism: ☐ Firearm ☐ Bladed weapon ☐ Other (specify) .....

Q14. Injury group:

- ☐ Head and facial injury (excluding eye injury)
- ☐ Eye injury
- ☐ Injuries to vertebral column, spine, internal organs, and rib/ sternum fractures
- ☐ Upper extremity injury (excluding nerves)
- ☐ Lower extremity injury
- ☐ Superficial injury, including contusions and open wounds
- ☐ Burns
- ☐ Poisoning
- ☐ Foreign body
- ☐ Other and unspecified injury

Q15. Place where the incident occurred:

- ☐ At the patient's home
- ☐ At someone else's home
- ☐ In the street
- ☐ At school
- ☐ In a public place (bar, concert, etc.)
- ☐ At the patient's workplace
- ☐ Other

Q16. Context of the incident:

- ☐ Assault
- ☐ Street fight
- ☐ School fight
- ☐ Domestic violence

Q17. Who inflicted the injury?:

- ☐ The patient (self-inflicted)
- ☐ Someone unknown to the patient
- ☐ Patient's partner/spouse
- ☐ A family member
- ☐ Other

Care provided

Q18. Did the patient require ambulance services? ☐ Yes ☐ No

Q19. What operations, if any, were/are being completed on the patient for treating this injury?

.....

.....

Q20. What drugs were/are used for treating this injury during and after his/her stay in the hospital?

Type of drug	Number of units prescribed
.....	.....
.....	.....
.....	.....
.....	.....
.....	.....

Q21. What physicians were consulted during the stay?

Physician type (IM, GP, FP, Specialist, etc.)	Number of consultations
.....	.....
.....	.....
.....	.....
.....	.....
.....	.....

Total number of consultations .....

Q22. What examinations were carried out on the patient?

Type of examinations	Number of consultations
.....	.....
.....	.....
.....	.....
.....	.....
.....	.....

Total number of consultations .....

Q23. Number of blood transfusions administered to the patient: .....

Q24. Estimated number of days the patient will be convalescing (i.e., not able to work) after leaving the facility: .....

Q25. Estimated number of outpatient visits the patient will undertake after leaving the facility: .....

Q26. Will the injury result in any long-term disability? ☐ Yes ☐ No

If yes, what type? ☐ Amputation ☐ Traumatic brain injury ☐ Spinal cord injury ☐ Other (specify) .....

Q27. Other observations:

.....

.....

ANNEX 2

Sample data sheet for hospital costs (to obtain from provider)

Q1. The average "hotel cost" per bed-day (i.e. the total budget of the facility minus the cost of drugs, operations, examinations, blood transfusions, physicians, etc. divided by the number of beds:

US$ .....

Q2. Average ambulance cost: US$ .....

Q3. Average cost per blood transfusion: US$ .....

Q4. Average cost per outpatient visit: US$ .....

Q5. Costs of prescribed medications identified

Type of medication	Cost per unit (US$)
.....	.....
.....	.....
.....	.....
.....	.....

Q6. Average cost per type of operation identified

Type of operation	Cost per unit (US$)
.....	
.....	
.....	
.....	

Q7. Average cost per type of physician consultation

Type of physical consultation	Cost per unit (US$)
.....	.....
.....	.....
.....	.....
.....	.....

Q8. Average cost per type of examination identified

Type of examination	Cost per unit (US$)
.....	.....
.....	.....
.....	.....
.....	.....

World Health Organization

Department of Violence and Injury Prevention and Disability
Avenue Appia 20
1211 Geneva 27
Switzerland
Tel +41-22-791-2064
Fax +41-22-791-4332
www.who.int/violence_injury_prevention
violenceprevention@who.int

ISBN 978 92 4 159636 7