TITLE: Communicating consequences with costs: A commentary on Corso et al.'s cost of injury

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Estimating the economic burden of injuries is important for setting priorities, allocating scarce health resources, and planning cost-effective prevention activities. As a metric of burden, costs account for multiple injury consequences – death, severity, disability, body region, nature of injury – in a single unit of measurement. In a 1989 landmark report to the United States congress, Rice et al. (1989) estimated the lifetime costs of injuries in the U.S. in 1985 [1]. By 2000 the epidemiology and burden of injuries had changed enough that the US Congress mandated an update, resulting in a book on the incidence and economic burden of injury in the U.S. [2]. To make these findings more accessible to the larger realm of scientists and practitioners and to provide a template for conducting the same economic burden analyses in other countries and settings, a summary (Corso et al., 2006 [3]) was published in Injury Prevention. Corso et al [3] reported that, between 1985 and 2000, injury rates declined roughly 15%. The estimated lifetime cost of these injuries declined 20%; totalling $406 billion, including $80 billion in medical costs and $326 billion in lost productivity. While incidence reflects problem size, the relative burden of injury is better expressed using costs.

Corso et al.'s (2006) costs have predominantly been used to express the burden of injury. In addition to the injury control community citing the costs to justify prevention, (e.g. [4-6]), the trauma research community use the costs to promote early trauma response and effective trauma management to improve patient outcomes and reduce health system costs (eg. [7-10]). Disability researchers use Corso et al. (2006) to highlight the burden of disability post injury (eg. [11 12]), and epidemiologists/statisticians use the paper to advocate the need for quality injury data to enable comparisons and evaluations (eg. [7 13-15]).

The impact has been considerable. In under a decade since first publication, Corso et al [3] has been cited almost 120 times and is classified as being in the Top 1% of papers in the Social Science field (according to Web of Science). While the paper enumerates the economic burden of injury in the United States, international citations include the United Kingdom [16], Europe [17] (including Spain [18], Finland [19], Germany [20], Belgium [21]), Taiwan [22], China [23], South Korea [24], Vietnam [25], Oman [26], Turkey [27], Quebec [28], Australia [29]and New Zealand [30] to name a few.

The 2000 update (Corso et al. 2006) to the 1985 study (Rice et al. 1989) benefitted from advances in the use and completeness of external cause coding. This allowed the authors to examine incidence and costs of injury by mechanism. Similar information by intent appeared in a companion paper [31]. In the future, with the expanded range of injury and external cause codes captured with the introduction of ICD-10-CM in

the U.S, and the ICD-11 revision internationally, a greater breadth and depth of injury costings will be derived from hospital discharge data.

A decade after Corso et al. (2006), researchers and others can query the CDC's Web-based Injury Statistics Query and Reporting System (WISQARS) to estimate injury costs (fatal, hospitalized, and emergency department treated and released) in the United States, including customizing the parameters of their analysis (mechanism, intent, body region, nature of injury, age group and more). These costs are based on the same methodology applied in Corso et al. (2006) and Rice et al. (1989). However, because WISQARS cost reports are based on the National Electronic Injury Surveillance System - All Injury Program (NEISS-AIP), a survey of injuries in 66 U.S. emergency departments, the small sample may not allow for analyses of less common injuries or at a detailed mechanism and intent level.

One important difference between Corso et al. (2006) and WISQARS compared to the original Rice et al. monograph [1] is the exclusion of quality of life costs or a non-monetized quality of life burden measure by request of the CDC. Quality of life costs place a dollar value on the pain, suffering, and lost functional capacity experienced due to death and injury. Economic theory shows that some measure of quality of life burden needs to be included in the costs in order to use them in cost-benefit or cost-effectiveness analyses of the return on investment of prevention [32]. The reluctance of the CDC to include these costs severely undervalues the societal burden of injury. Considerable advances in the quantification of injury burden have occurred, with studies such as Injury VIBES [33]aiming to provide an evidence base for better calculating injury burden using data from large prospective injury cohort studies from five countries. US safety agencies use meta-analyses of the growing body of literature to improve their translation of functional capacity losses in quality-adjusted life year losses [34 35]. As tools and methodologies improve, incorporating quality of life into burden of injury studies should become more routine.

A previous *Injury Prevention* commentary noted that WISQARS (and, by extension, Corso et al., 2006, and Rice et al., 1989) limits the scope of costs to those of the victim [36]. Hemenway (2011) argues that this view is misleading for street violence and can lead to inefficient policy and programming decisions by not taking into account additional costs to friends, family, and the community. These include costs of adjudication and sanctioning, consequences related to exposure to violence, declines in the economic value of high-crime communities and mental and behavioural changes of its citizens. Likewise, the U.S. National Highway Traffic Safety Agency would argue to include costs of property damage, travel delays, crash-related emissions, liability lawsuits and insurance claims processing in motor vehicle crash costs. The U.S. Fire Administration would include structural and property damage in the cost of fires and burns. Including these cost categories generates a more authentic cost of injury to society.

As the response to Corso et al. (2006) over the past decade shows, and despite the costs not accounted for in the 2006 article, the policy process was served well by having uniformly calculated, peer-reviewed and credible estimates. Communicating both the health and financial burden of injury is a valuable tool in understanding the burden of the problem and setting priorities for prevention. A decade later, costing methodologies have evolved, electronic data are more accessible, and external cause coding quality and

completeness has improved. The time is ripe for a detailed update of the cost of injuries internationally, with a look at injury prevention successes and the savings from prevention.

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