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The economic burden of injuries in British Columbia: Applying evidence to practice

Physicians and policymakers can support broader prevention initiatives for falls, transport incidents, unintentional poisoning, and self-harm by making use of data from a study quantifying injury costs.

ABSTRACT

Background: **Approximately 2000 deaths and 8000 cases of permanent disability result from injury every year in BC. Quantifying the economic and societal burden of injury can provide physicians and policymakers with comprehensive data to support the development and implementation of broader injury prevention initiatives.**

Methods: **Disability-adjusted life years and total costs were calculated using an incidence costing, human capital, societal perspective approach. Data were collected and analyzed for the four leading causes of injury: falls, transport incidents, unintentional poisoning, and self-harm. The Burden Calculator and Electronic Resource Allocation Tool were used to establish direct and indirect costs of injury using data from a number of sources, including hospitals and emergency rooms.**

Results: **Unintentional poisoning and self-harm resulted in the highest number of years of life lost and gross cost, while falls and transport incidents resulted in the greatest number of years lived with disability. In 2013 the gross cost for the leading causes of injury ranged from $547 million to $922 million. The total cost of injury increased between 2004 and 2013.**

Conclusions: **Health professionals are ideally positioned to support injury prevention initiatives and provide appropriate patient counseling. Physicians and policymakers can help combat rising injury rates and related costs by applying evidence from the study of injuries in BC. Increased effort should be made to prevent injuries caused by falls, transport incidents, unintentional poisoning, and self-harm.**

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Background

Injuries are the leading cause of death among British Columbians age 1 to 44, and the fifth leading cause of death among Canadians of all ages.[1,2] Every year in BC approximately 2000 deaths and 8000 cases of permanent disability result from injury.[2] Beyond the injured person, there are far-reaching consequences for families, communities, the health care system, and society at large. This public health issue directly affects the practice of physicians who must care for these people.

In the past decade, efforts have been made to consider the economic cost of injury and the related societal

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burden of death and disability, and to enlighten decision-makers regarding the extent of the injury issue.[2] Injury costs in BC in 2010 amounted to $3.7 billion in both direct and indirect costs.[2] To reduce the burden on the health care system and society, physicians and policymakers must be informed of the economic cost of injury so they can support cost-effective primary and secondary injury prevention initiatives.[3]

There are several approaches to measuring economic burden of illness or injury, but a simple way is to measure the direct costs. The cost-of-illness approach generally follows one of two methods: incidence costing or prevalence costing. Both approaches produce the same results for steady-state chronic health problems and conditions that are short-term in nature. However, if policymakers want to assess the benefits of reducing the incidence of injuries, the incidence method is more useful and accurate. Incidence costing estimates the lifetime direct and indirect costs of new cases of injury that have their onset in a given year.[2] Combined with a societal perspective, it provides a useful starting point when illustrating the full burden of injury for physicians and policymakers.

The disability-adjusted life year is a common measure of disease or injury burden, based on the core principle that everyone should live a long life in full health.[4,5] Disability-adjusted life years are calculated as the sum of years of life lost due to premature death and years lived with disability to provide a single measure describing the total health loss at the population level.[4] The disability-adjusted life year permits comparisons with previous years or between communities, and can be used to monitor the effectiveness of new injury prevention programs or laws.[6] From a clinical perspective, the disability-adjusted life year offers a comprehensive measure of the relative magnitude of the injury issue and provides physicians and policymakers with reliable and practical information for advising patients and developing effective injury prevention initiatives.

A study was proposed to calculate the cost of treating injuries in BC, the impact of years of life lost to death or disability, and the economic loss of diminished labor market productivity and earnings. Such findings are needed to raise awareness about the burden of injury, to provide physicians with comprehensive information for discussions with patients, and to assist policymakers in the development and implementation of broader injury prevention initiatives.

Methods

The economic and societal burden of injury over time in BC was quantified using an incidence costing,[5] human capital, societal perspective approach.[4,6] The total economic impact of injury was assessed by including costs borne by the health care system as well as productivity lost to death or disability over the course of an individual's life. Injury and premature injury-related deaths were translated into direct and indirect costs to estimate what the societal gain would have been if these injuries and deaths had been prevented.[5,7] Direct costs were defined as all health care costs, including expenditures for hospitalization, physician and health professional services, pharmaceutical drugs, and rehabilitation treatment. Indirect costs were defined as the total productivity loss to society due to injuries that prevented individuals from performing their normal activities. These costs were calculated by considering mean individual earnings in relation to time loss from work over the relevant period within the working life of an individual age 15 to 64.

Other economic factors considered included wage rates, participation rates, unemployment rates, income loss due to disability, and real wage growth rates, which were all discounted at a rate of 3%.

Calculation

The Burden Calculator,[8] an open-source analytic tool, was used to estimate disability-adjusted life years for the leading causes of injury: falls, transport incidents, unintentional poisoning, and self-harm.[2] The calculation applied disability weights,[9] which reflected the severity of the health decrement on a scale from 0 (perfect health) to 1 (dead). The disability-adjusted life years were then translated into 2013 dollars using the gross national income per capita.[6]

The Electronic Resource Allocation Tool,[2] developed by Parachute Canada, was used to calculate both direct and indirect costs. The tool combines existing data with variables from the literature in order to model the full costs of unintentional and intentional injuries.[2] Direct and indirect costs were calculated for the most recent year of data available (2013), with results from previous injury cost studies used for comparison.[10] Direct mortality costs were also estimated on a complete episode of events due to an injury-related death. Costs from previous years (2004 and 2010) were converted to 2013 dollars using the consumer price index to account for inflation and to allow for direct comparison.

To capture the effects of variations in direct and indirect costs of injuries, sensitivity analyses were conducted using variations in the discount rate of 1%, 3%, and 5%, unemployment rate, and average weekly earnings.

Data

Data used for this study were collected from a number of sources, including hospitals and emergency rooms (Table 1). To allow for comprehensive documentation of all costs associated with injuries, proxy measures were also developed using the methodology of Miller and colleagues.[11] Direct morbidity costs for out-of-hospital injury treatment were calculated using ratios of episodes and related costs of emergency room visits to hospitalized cases. The incidence of both permanent partial and total disability were estimated using coefficients that relate these episodes and costs to the incidence of hospitalized and emergency room injury cases.

Results

Injuries in BC resulted in 2110 deaths, 37 207 hospitalizations, 482 687 emergency room visits, and 8911 permanent disabilities in 2013 (Table 2). The leading cause of death was falls, which accounted for 30% of all injury-related deaths. The second leading cause of death was unintentional poisoning, followed by suicide/self-harm (other) and transport incidents.

Looking at the four leading causes of injury, unintentional poisoning and self-harm resulted in the highest number of years of life lost and gross cost, while falls and transport incidents resulted in the highest number of years lived with disability. The gross cost for the leading causes of injury in the years studied ranged from $547 million to $922 million (Table 3).

Economic burden

Injuries cost British Columbians $4.1 billion in 2013, with 64% of this in direct cost ($2.62 billion) and 36% in indirect cost ($1.48 billion). Permanent disability was responsible for the greatest economic burden of injury at $1891 million, followed by

Table 1. Data sources for study of economic burden of injuries in BC.

Type of data	Estimate calculated	Data source
Mortality data	Death costs	BC Vital Statistics
Hospitalization data	Hospital costs and length of stay	Discharge Abstract Database, BC Ministry of Health
Emergency room data	Emergency room visits	Extrapolated data from National Ambulatory Care Reporting System, Canadian Institute for Health Information
Disability data (unemployment, labor force participation, average wage rates) Life expectancy year tables	Cost of productivity losses from morbidity and premature death	Statistics Canada
BC population data	Injury rates and per capita costs	BC Statistics

Table 2. Number of injury-related events and incidence rates in BC by cause of injury, 2013.

Cause	Deaths (rate per 100 000)	Hospitalizations (rate per 100 000)	Emergency room visits (rate per 100 000)	Permanent disability (rate per 100 000)
Falls	635 (13.8)	20 902 (455.5)	146 170 (3185.2)	3731 (81.3)
Transport incidents	275 (6.0)	4527 (98.6)	39 336 (857.2)	1227 (26.7)
Unintentional poisoning	420 (9.2)	1657 (36.1)	7369 (160.6)	352 (7.7)
Suicide/ self-harm (poisoning)	127 (2.8)	2561 (55.8)	3272 (71.3)	568 (12.4)
Suicide/ self-harm (other)	364 (7.9)	344 (7.5)	924 (20.1)	59 (1.3)
Violence	45 (1.0)	1130 (24.6)	13 651 (297.5)	298 (6.5)
Other injuries	244 (5.3)	6086 (132.6)	271 966 (5926.4)	2676 (58.3)
Total	2110 (46.0)	37 207 (810.8)	482 687 (10 518.3)	8911 (194.2)

Table 3. Impact of disability-adjusted life years in BC by four leading causes of injury, 2013.

Cause of injury	Years of life lost	Years lived with disability	Disability-adjusted life years	Gross cost per disability-adjusted life year* (millions)
Transport incidents	9993	1406	11 399	$569
Falls	8549	2396	10 945	$547
Unintentional poisoning	18 384	66	18 450	$922
Self-harm	18 280	152	18 432	$921

*Based on 2013 per capita income of Can$49 965 (US$39 601)

outpatient treatment costs of $805 million (Table 4).

Falls resulted in the highest costs for inpatient treatment ($498 million), outpatient treatment ($232 million), and permanent disability ($635 million). Unintentional poisoning resulted in the highest total death cost ($201 million) and highest cost per patient death ($47 414). Suicide/self-harm (other) was the second highest for total death cost ($150 million).

Sensitivity analysis

Analyses using discounted rates of 1%, 3%, and 5% revealed high sensitivities to these variations and resulted in significant differences in total, direct, and indirect costs of injuries. Lowering the discount rate to 1% increased total costs by 21.2%, direct costs by 18.6%, and indirect costs by 25.4%. Conversely, raising the discount rate to 5% decreased total costs by 15.1%, direct costs by 11.7%, and indirect costs by 21.1%. The analyses for unemployment rate and average weekly earnings variations indicated minimal sensitivities and minimal effect.

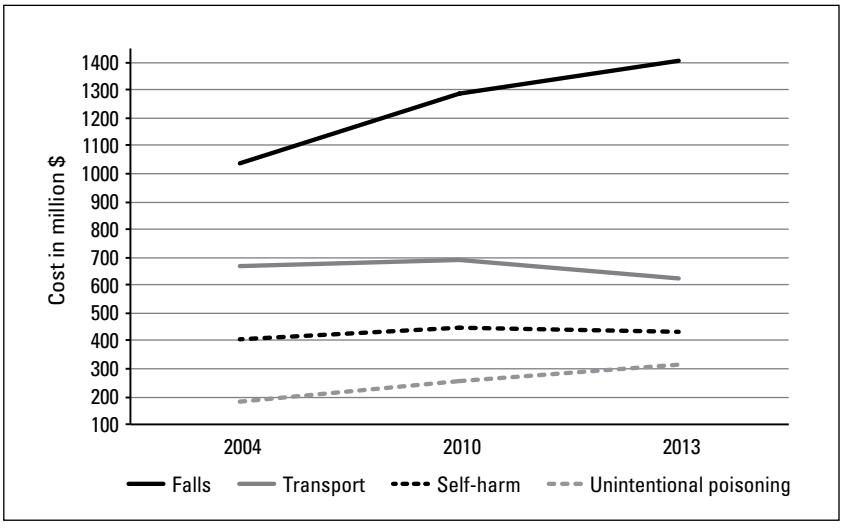

Figure. Total cost of injuries in BC by four leading causes, 2004 to 2013.

Costs over time

From 2004 to 2013, the total cost of injury in BC increased from $3.3 billion to $4.1 billion, a 24.4% increase over 9 years. While the cost of transport-related injuries decreased by 7.1%, increases in cost were seen for falls (35.5%), unintentional poisoning (75.6%), and self-harm (6.0%) (Figure). From 2004 to 2010, the total cost of injury increased by an average of 2.6% per year, and then from 2010 to 2013 increased by a lesser average of 1.3% per year. From 2004 to 2010, increases in the average cost per year were seen for falls (3.4%), unintentional poisoning (6.3%), self-harm (1.5%), and transport incidents (0.5%). From 2010 to 2013, increases continued for the average cost per

Table 4. Cost in dollars for injuries in BC by cause and injury outcome, 2013.

Cause	Death		Inpatient treatment		Outpatient treatment		Permanent disability		Overall costs	
	Total cost* (millions)	Per death cost	Total cost (millions)	Per treatment cost	Total cost (millions)	Per treatment cost	Total costs (millions)	Per injury cost	Total cost (millions)	Per person cost
Falls	42	65 908	498	23 808	232	1586	635	170 148	1406	136
Transport incidents	118	427 759	109	24 096	77	1965	320	261 192	624	306
Unintentional poisoning	201	479 414	22	13 053	8	1141	84	239 048	316	69
Suicide/self-harm (poisoning)	45	356 966	32	12 328	4	1132	170	299 397	251	55
Suicide/self-harm (other)	150	412 718	8	24 328	2	2015	19	327 259	180	39
Violence	21	474 626	19	17 070	20	1449	92	307 618	152	152
Other injuries	90	369 866	118	19 315	393	1443	570	213 160	1171	255
Overall	$668	$316 592	$805	$21 639	$735	$1524	$1891	$212 198	$4100	$893

*Due to rounding, numbers do not add up precisely to totals shown.

year for falls (2.3%) and unintentional poisoning (5.5%), while decreases were seen for self-harm (1.0%) and transport incidents (2.5%).

Conclusions

This study quantifies the economic and societal burden of injury in BC. At the time of writing, it was the first review of costs using 2013 data, the most recent available.

The economic analyses reveal that the burden is equivalent to one injury-related death every 4.2 hours and an expenditure of $467 980 every hour.[12] The significance of this burden is such that preventing injury is a top priority of the Provincial Health Services Authority.[13] Physicians are ideally positioned to provide guidance to health authority operational leaders regarding effective strategies and top injury issues, as well as to engage in community-based prevention efforts and patient counseling. Investing time and effort in counseling and injury prevention saves lives and health care resources and reduces disabilities. Previous studies have shown that every dollar spent on zero alcohol tolerance for drivers under 21 years of age produces savings of $25,[12] and that injury prevention counseling from health care providers to parents is positively associated with safety behaviors.[14]

The results of this study indicate that unintentional poisoning, self-harm, transport incidents, and falls require attention, as they represent the highest disability-adjusted life year costs. As children and youth have the most potential life remaining, they are a priority population for primary prevention efforts and provide a meaningful opportunity to reverse this societal and economic loss.

Physicians who understand the nuances of the injury burden gained from studying costs can apply this evidence in their own practices using the many resources and tools available (**Table 5**). They can address the burden of self-harm by connecting youth to mental health services such as Foundry. They can use resources such as Parachute Canada to educate parents of toddlers about risks in the home associated with improperly stored cleaners and medications. They can also address unintentional poisoning associated with drugs and alcohol by discussing social support programs with patients, and address disability from falls by discussing fall prevention using resources such as Finding Balance BC.

Injury prevention

While the results of this study indicate that falls and unintentional poisoning have contributed to increased injury

Table 5. Injury prevention resources and tools.

Injury type	Resource	Link	Description
Falls	Health Link BC	www.healthlinkbc.ca/health-topics/ug2329spec#tp21184	• Fall prevention suggestions for seniors
	Finding Balance BC	https://findingbalancebc.ca	• Risk assessment tools and fall prevention courses for practitioners • Multilingual educational resources for seniors • Fall prevention campaign toolkit
Transport incidents	Screening and Brief Intervention Training for Trauma Care Providers	http://vghtrauma.vch.ca/injury-prevention/sbirt http://vghtrauma.vch.ca/new-sbirt-clinical-tools/	• Videos about the SBIRT program (Screening, Brief Intervention, and Referral to Treatment) • Patient pamphlets • Screening tools for practitioners • Clinical tools
Unintentional poisoning	Parachute Canada	www.parachutecanada.org	• Information for parents and others regarding many injury topics pertinent to children
Self-harm	Crisis Intervention and Suicide Prevention Centre of British Columbia	https://crisiscentre.bc.ca	• Training in suicide prevention and skillful responding for service providers • Crisis chat services • Mindfulness training • Support for families
	Foundry	https://foundrybc.ca	• Support and services for youth and their families

costs over time, the overall annual increase has slowed from 2.6% (2004 to 2010) to 1.3% (2010 to 2013), suggesting that injury prevention interventions are having an effect. After publication of the Economic Burden of Injury in Canada report,[10] policymakers in BC acknowledged the necessity of investment in prevention to reduce the impact of injury. Following several years of concerted effort and planning, a public health report was published[15] and programs were launched, including Preventable, a province-wide injury prevention social marketing campaign.[16]

One program that may have contributed to the decrease in self-harm costs from 2010 to 2013 is the Crisis Intervention and Suicide Prevention Centre of British Columbia.[17] The centre provides emotional support to youth, adults, and seniors in distress and offers immediate access to websites and chat lines—an early intervention approach designed to prevent a crisis from escalating and turning into a tragedy. Another example of early intervention is the SBIRT (Screening, Brief Intervention, and Referral to Treatment) program[18] implemented at the Vancouver General Hospital Trauma Centre in 2014.[19] The program addresses alcohol as a risk factor, identifies those at risk, and connects them with appropriate services in an effort to reduce alcohol-related injuries ranging from motor vehicle crashes and pedestrian injuries to falls and assaults. Despite these achievements, the cost of transport-related and self-inflicted injuries remains high, indicating that continued focus and efforts to improve prevention are needed to achieve further reductions. This is especially the case with unintentional poisoning hospitalizations and deaths, the majority of which are caused by drugs.[20]

The increase in costs for unintentional poisoning might be explained in part by the opioid crisis in BC and the rising number of drug overdoses and deaths since 2006. Following the public health emergency declared in BC in April 2016,[21] many programs were developed to prevent drug overdoses and provide emergency response to victims, including the Overdose Prevention Outreach Team of the Vancouver Area Network Drug Users that facilitates access to life-saving naloxone kits.[22] These actions have slowed the rate of unintentional poisoning from opioids[21] and contributed to greater awareness of risks.

The increase in costs for falls might be explained in part by the aging population in BC.[23] The need to reduce falls is recognized on the Health Link BC website, where fall prevention resources are available in eight languages.[24]

Limitations of study

The human capital approach used to measure indirect costs in this study produced a conservative estimate because costs were assigned only for injured people age 15 to 64 and not for those who leave the workforce to provide care for injured family members. Furthermore, we were not able to quantify and include costs associated with injuries such as pain and suffering, economic dependence, and social isolation that have a profound impact on affected individuals, families, and communities.

Summary

The purpose of this study was to quantify the economic and societal burden of injury in BC and provide comprehensive data to support physician discussions with patients and encourage engagement with injury prevention initiatives. Investing in primary prevention has the greatest potential to reduce the incidence and severity of injuries, including premature death, and produce significant savings in health care costs.[25-27]

While a wide range of recent and ongoing efforts have addressed injury prevention in BC, rising costs indicate that strategic action is required.

While a wide range of recent and ongoing efforts have addressed injury prevention in BC, rising costs indicate that strategic action is required to achieve further reductions in unintentional poisoning, self-harm, transport incidents, and falls, as injuries from these produce most of the economic and societal burden. Physicians and other health care professionals are ideally positioned to participate in implementing the provincial action plan for injury prevention and to support priority prevention initiatives in their own communities and provide appropriate patient counseling during office visits. BCMJ

Competing interests
None declared.

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