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The Cost of Injury in Ontario

Report

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Public Health Ontario

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Authors

Sarah A. Richmond, PhD
Applied Public Health Science Unit
Health Promotion, Chronic Disease & Injury Prevention
Public Health Ontario

Fahra Rajabali, MSc
Researcher
British Columbia Injury Research and Prevention Unit
BC Children's Hospital

Ian Pike, PhD
Director
British Columbia Injury Research and Prevention Unit
BC Children's Hospital

Daniel Harrington, PhD
Director
Health Promotion, Chronic Disease & Injury Prevention
Public Health Ontario

Acknowledgements

Contributor
Alexia Medeiros, MPH
Epidemiologist
Health Promotion, Chronic Disease & Injury Prevention
Public Health Ontario

Contributor
Varsha Doguparty, PhD (c)
Epidemiologist
Health Promotion, Chronic Disease & Injury Prevention
Public Health Ontario

Contributor
Justin Thielman, MPH
Epidemiologist Lead
Health Promotion, Chronic Disease & Injury Prevention
Public Health Ontario

Reviewer
Tracy Silva RN, BScN
Program Manager, Injury Prevention & Community Approach for Children and Youth
Injury Prevention, Healthy Aging, and Built Environment (IPHABE) Team
Healthy Living Division, Public Health Branch, Community & Health Services Department
York Region Public Health

Reviewer
Silvana Farrace-Perry RN, BScN
Public Health Nurse, Injury Prevention & Community Approach for Children and Youth
Injury Prevention, Healthy Aging, and Built Environment (IPHABE) Team
Healthy Living Division, Public Health Branch, Community & Health Services Department
York Region Public Health

Reviewer
Meagan Lichti RN, BSCN
Public Health Nurse, Chronic Disease and Injury Prevention Team
Southwestern Public Health

Reviewer
Peter Heywood, BASc, MPA, CPHI
Program Director, Community Health Division
Southwestern Public Health

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Executive Summary

Preventable injury is a significant public health concern in Ontario. Every day, over 4,000 people in Ontario present to the emergency department, 280 are hospitalized, and 23 die as the result of an injury. For children and youth ages 0–19 years, suicide and self-harm is the leading cause of injury-death, unintentional poisoning for adults ages 20–64 years, and falls for older adults, age 65 years and older. These injuries and deaths affect both the individuals involved in the event, their families and the health care system. To better address and prevent injuries, practitioners require information across the public health approach to prevention, including both the human and economic burden of injuries.

This report summarizes both the direct and indirect cost of injury to people in Ontario in 2019. This report is published in collaboration with Parachute, and the British Columbia Injury Research and Prevention Unit, at the University of British Columbia. Most importantly, this report was co-developed and informed by injury practitioners across Ontario public health units to increase its use in practice. This is the first provincial report on the cost of injury in Ontario since 2015 using updated methodology and analyses, and reports the cost of injury across the leading injury mechanisms.

This report presents both unintentional and intentional injuries in Ontario. Key findings of this report are:

- Injuries cost Ontario $12.2 billion in 2019
- 8,258 deaths
- 101,894 hospitalizations
- 1,480,585 emergency department visits
- 22,621 short-term and long-term disabilities
- $7.6 billion in direct health care costs
- $4.6 billion in indirect costs or productivity losses
- $65.4 billion in the value of statistical life

In the 2015 Cost of Injury Report in Canada, it was estimated that injuries cost Ontario $8.8 billion and 5,785 lives in 2010. Further, injury resulted in over 1.3 million emergency department visits, over 70,000 hospitalizations, and left over 20,000 people in Ontario with total disability. Given the data presented in this report, the absolute cost of injury has increased 30% in less than a decade. The per capita cost of injury in 2010 was $667, rising to $838 in 2019.

Public health practice for injury prevention is changing in Ontario. The COVID-19 pandemic called into action injury prevention practitioners across the province to fill positions addressing the spread of COVID-19. Since this time, practitioners have been returning to their home positions in injury prevention and working hard to plan and develop programs of public health to address the many causes of injury in this province. This report aims to provide practitioners with information specific to the economic cost of preventable injury to be used as a tool to invite more work in this area, particularly given the predictable and preventable nature of injuries.

Introduction

Preventable injury is a significant public health concern in Ontario. Every day, over 4,000 people in Ontario presented to the emergency department, 280 were hospitalized, and 23 people died each day in 2019 as the result of an injury. For children and youth ages 0–19 and adults ages 20–44 years, intentional self-harm and unintentional poisoning were the leading cause of injury-deaths in 2019, respectively. For older adults ages 65 years and older, falls was the mechanism with the highest rate of injury mortality. These injuries and deaths affect both the individuals involved in the event, their families, and the health care system. Often, people in Ontario characterize injuries as "accidents" and view these significant injuries as unavoidable incidents that just "happen". Injuries are; however, predictable and preventable events. Prioritizing injury prevention efforts through implementation of evidence-based interventions can reduce not only the frequency, but severity of injurious events. For example, reducing speed not only decreases the risk of collision, but decreases the severity of injuries when a collision occurs[1]; exercise programs that increase both power and strength in older adults significantly reduce the number and severity of falls[2], the leading cause of injury death in this population[3].

This Cost of Injury Report uses the number of injuries and deaths due to injury in Ontario in 2019 and compares these results to the 2015 Cost of Injury Report, reporting 2010 data. The main objectives of this report are to:

1. Provide an update of the total economic cost of unintentional and intentional injures in Ontario
2. Provide a breakdown of the costs of injury by the leading injury mechanisms, age and sex
3. Compare, where applicable, the 2019 costs of injury to the 2015 costs of injury

Methods

We completed this analysis in collaboration with the British Columbia Injury Research and Prevention Unit (BCIRPU) and Parachute, Canada's national injury prevention not-for-profit organization that aims to increase awareness and action for preventable injuries. Aligning with the other Cost of Injury Reports across Canada, the analytical approach for this report used the injured population of Ontario in 2019, and projections over the period of each injured person's lifetime. This report presents the direct and indirect costs of injury from a societal perspective, using an incidence costing, human capital approach.[4] We also present a Value of Statistical Life (VSL) estimate in this report.

Typically thought of as costs associated with primary care and hospitalizations, direct costs also include those that monetize the resources used to treat the injury, rehabilitate the injured person, as well as the costs associated with caring for the injured person to the time of their death. Indirect costs represent costs associated with the loss of productivity to society due to injury. These costs also include those associated with the loss of productivity to those responsible for caring for the injured person. Table 1 outlines the list of direct and indirect costs included in our analyses.

Table 1: Direct and Indirect Cost Measures Used in Calculation of Injury Cost in Ontario

Cost Category	Data Source for Cost Information
Lifetime medical costs of injuries	
Average emergency department cost	Canadian Institute for Health Information https://www.cihi.ca/sites/default/files/document/hospital-spending-highlights-2020-en.pdf
Average hospital case cost	Canadian Institute for Health Information https://yourhealthsystem.cihi.ca/hsp/inbrief?lang=en#!/indicators/015/cost-of-a-standard-hospital-stay/;mapC1;mapLevel2;/
Coroner or medical examiner services and autopsy average costs	Ministry of Solicitor General, 2019 (estimating Canadian costs using Ontario data from the Office of the Chief Coroner and Ontario Forensic Pathology Service https://www.auditor.on.ca/en/content/annualreports/arreports/en19/v1_308en19.pdf
Ambulance service average costs	Estimated using Toronto Paramedic Services https://www.toronto.ca/legdocs/mmis/2015/ex/bgrd/backgroundfile-77463.pdf
Physician care expenditures	Canadian Institute for Health Information. Canadian Institute for Health Information. National Physician Database — Utilization Data, 2020-2022. https://www.cihi.ca/en/national-physician-database-metadata
Average funeral costs	Life Insurance Canada, 2018 https://lsminsurance.ca/life-insurance-canada/2017/11/funeral-cost-canada
Lifetime productivity losses due to injuries and deaths	
Average weekly earnings, labour participation rate and unemployment rate	Statistics Canada, Table 14-10-0018-01 Labour force characteristics by sex and detailed age group, annual https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=1410032702&pickMembers%5B0%5D=4.1&cubeTimeFrame.startYear=2018&cubeTimeFrame.endYear=2018&referencePeriods=20180101%2C20180101 Statistics Canada. Table 14-10-0204-01 Average weekly earnings by industry, annual https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=1410020401&pickMembers%5B0%5D=1.1&pickMembers%5B1%5D=2.1&pickMembers%5B2%5D=3.2&cubeTimeFrame.startYear=2018&cubeTimeFrame.endYear=2018&referencePeriods=20180101%2C20180101
Loss of Life (Value of a Statistical Life)	Average VSL applied to the number of deaths Chestnut LG, De Civita P. Economic Valuation of Deaths Risk Reduction: Review and Recommendations for Policy and Regulatory Analysis. Ottawa: Policy Research Initiative. (2009)

Where applicable, cost values were converted to 2019 dollar values using the Bank of Canada inflation calculator https://www.bankofcanada.ca/rates/related/inflation-calculator/

In addition to the direct and indirect costs of injury presented in this report (using a human capital approach) we also present a VSL estimate. The human capital approach only considers lost earnings due to an injury or death in those ages 15–64 years. The VSL; however, is a willingness-to-pay measure to prevent fatalities in society inclusive of all people in Ontario (i.e., those less than 15 years of age and older than 64). It is conventionally defined as the socially acceptable, additional costs to society for improvements to safety and injury prevention that reduce the population-level expected number of fatalities by one. At an individual level, the VSL is derived from an individual's willingness to exchange their own money for a small change in their own risk of death in a defined period (often one calendar year). At a population level, this monetary estimate represents the collective value placed on mortality risk reduction. For example, if a policy aims to reduce the risk of death in 10,000 people by 1 in one year; one fewer death is expected in that year. VSL estimates can play a large role in a cost-benefit assessment for the introduction of health policies including transportation and the environment.[5] The VSL is used to drive the benefit side of the cost-benefit analysis. This report aims to present and interpret estimates of VSL in 2019 in Ontario that can be used in future cost-benefit analyses of policy interventions to mitigate fatalities due to preventable injury.

Costing Calculations

We used the Electronic Resource Allocation Tool (ERAT) to analyse the direct and indirect costs of each injury mechanism, by age group and sex for the year 2019. The ERAT is a tool that can be updated as new data become available, including increases or decreases to the population, injury incidence, inpatient and outpatient treatment patterns, and average hospital use costs. Use of the tool allows researchers and practitioners at the provincial and local level to compare injury costs to previously published literature[6] as well as to support resource allocation, policy development, and decision-making. Following this methodology increases consistency in how the cost of injury is reported across provinces, and increases our ability to compare data over time.

Direct costs were calculated by estimating the cost associated with the complete episode of death, emergency care, hospitalization, physician fee services, ambulance transportation, and rehabilitation for the injury.[4] Indirect costs associated with time away from work was calculated for each individual by determining foregone earnings as a calculation of average earnings, adjusted by the participation rate and unemployment rate, over the working life of an individual ages 15–64 in Ontario. Both direct and indirect costs were discounted to 2019 dollars at 1.5 per cent per annum.[7] This discounting is applied to account for the fact that future costs are usually less than present costs due to scientific and technological advancement. A real wage growth rate of 1% per year was assumed for this study.[4]

This report does not provide a total number of injuries across indicators used in this report (i.e., deaths, hospitalizations, ED visits and disability cases). To accurately estimate the cost associated with each indicator (e.g., the cost of all presentations to the ED) we included all cases, that then if summed across indicators, would include duplicate cases. For example, if a person was treated in the ED and then was subsequently admitted to hospital, they would be counted both as an ED case and a hospitalized case. We calculate cases in this way as that individual incurred both ED and hospital costs.

Data Sources

Injury emergency department (ED) visits, hospitalizations, and deaths across all ages and sexes in Ontario were extracted from IntelliHealth databases at Public Health Ontario. Emergency department visits were extracted from the National Ambulatory Care Reporting System (NACRS), hospitalizations using the Discharge Abstract Database (DAD) and deaths from the Vital Statistics (VS) database. A certified IntelliHealth user pulled all cases of unintentional and intentional injuries identified for use in this report using the external cause of injury codes, classified by the World Health Organization, International Classification of Diseases, 10th revision (ICD-10). A full list of injury codes used in this analysis can be found in the Appendix.

Injury Deaths in Ontario

Death data were extracted from the VS database, accessed through IntelliHealth at Public Health Ontario. The total number of deaths by age group (0–4, 5–9, 10–14, 15–19, 20–24, 25–64, 65–74, 75–84, 85 years and older) and sex (female, male) from January 1, 2019 to December 31, 2019 were extracted. We defined injury deaths by identification of an ICD-10 CA external cause code from V01-Y36, inclusive. See the Appendix for the specific ICD-10 CA codes used in this study. We estimated direct death costs based on a complete episode of death, due to injury. This included costs incurred at the scene of a death, any ambulance transportation costs, treatment costs occurring in the ED and in hospital prior to death, as well as coroner, autopsy and funeral costs.

Hospitalizations in Ontario

The total number of hospitalizations and length of stay in hospital by age group (0–4, 5–9, 10–14, 15–19, 20–24, 25–64, 65–74, 75–84, 85 years and older) and sex (female, male) were derived from the DAD, through IntelliHealth access at Public Health Ontario. We derived Resource Intensity Weights (RIWs) used to calculate the average cost of each hospitalization from the DAD. The RIW is a total relative case weight that is associated with specific hospital resource costs such as medical diagnosis, surgical procedures and medical supplies.[4] We used the average RIW and average length of stay applied to the total number of hospitalizations in Ontario in 2019. Hospitalization admissions from January 1, 2019 to December 31, 2019 were included. We defined injury hospitalizations by identification of an ICD-10 CA external cause code from V01-Y36, inclusive. See the Appendix for the specific ICD-10 CA codes used in this study.

Emergency Department Visits in Ontario

The total number of ED visits by age group (0–4, 5–9, 10–14, 15–19, 20–24, 25–64, 65–74, 75–84, 85 years and older) and sex (female, male) were derived from NACRS, through IntelliHealth access at Public Health Ontario. NACRS is a population-based representative sample of ED visits in Ontario. Presentations to the ED from January 1, 2019 to December 31, 2019 were included. We defined injury ED visits by identification of an ICD-10 CA external cause code from V01-Y36, inclusive. See the Appendix for the specific ICD-10 CA codes used in this study. The ERAT uses direct morbidity costs for out-of-hospital treatment related to injuries, using ratios of episodes and related costs of non-hospitalized to hospitalized cases from the United States as Canadian data were unavailable.[8]

Disability in Ontario

Disability was measured for hospitalizations and ED visits by applying disability weights to the nature of injury diagnostic codes within each of the external causes. Disability weights, which reflected the severity of the health decrement on a scale from 0 (perfect health) to 1 (dead),[7] were available for short-term (within the year of injury) and long-term (12-months to lifetime) disability.[9] Long-term disability was categorized as permanent partial and permanent total disability. The ERAT estimates partial disability based on an individual's ability to partially returning to some form of employment before end of life and total disability as the inability to return to employment.[8] Disability incidence was used to calculate medical, rehabilitation and caregiving costs.

The life expectancy data, average wage rates, unemployment and labor force participation rates in Ontario used to estimate the cost of productivity losses from morbidity and premature death, were obtained from the Statistics Canada CANSIM database. The number of cases of both partial and total disability were obtained by applying the proportion of employment in Ontario to disability incidence.

Ontario Population

Estimates of the Ontario population were obtained by census data from Statistics Canada. We used the estimated population by age group and sex, in 2019.

Despite the breadth of data used to estimate the costs associated with injury in Ontario in 2019, these data are insufficient to provide a comprehensive documentation of all costs associated with injuries. For example, there are certain intangible costs associated with poisonings, such as pain and suffering, economic dependence, and social isolation that are difficult to quantify in economic terms, and were therefore excluded from the cost calculations.

This report will present data divided into five sections:

1. Total cost of injury: (cases and rates of injury in Ontario)
2. Unintentional and intentional injury costs to the health system and society: (total, direct, and indirect costs of injury)
3. Costs by injury mechanism: (total, direct and indirect costs by injury mechanism) and Ontario injury priorities including: falls, unintentional poisoning and transport incidents): (costs by age and sex for specific types of falls, unintentional poisoning and transport incidents)
4. Costs by age group: (costs by injury mechanism, age group and sex)
5. Comparison of the costs associated with injury in 2019 to the costs associated with injury in 2010

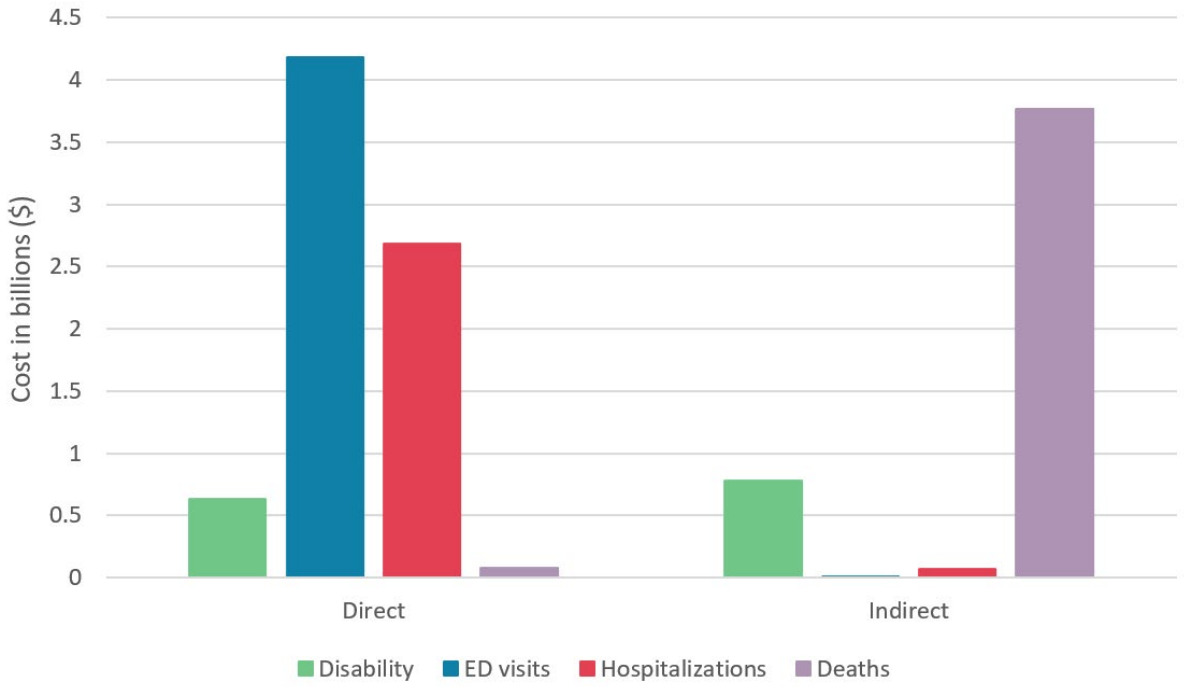
Total Costs of Injury

A total of 8,258 lives were lost to injury in Ontario in 2019. There were a further 101,894 hospitalizations, and 1.48 million ED visits due to injury (Table 2). There were a total of 22,621 people that were injured sufficiently to cause both short and long term disability (Table 2). The total direct costs of injury was $7,568,793,735, total indirect costs were $4,619,480,849. Figure 1 highlights the total direct and indirect cost of injury, by injury indicator.

Table 2: Frequency and Cost of Injury by Injury Indicator

Indicator	Frequency, Cost	Rate (Per Capita Cost)
Deaths	8,258	56.8/100,000 ($264.12)
Hospitalizations	101,894	700.56/100,000 ($189.33)
Emergency department visits	1,480,585	10,179.5/100,000 ($2,822.32)
Total disability	22,621	155.53/100,000 ($97.24)
Total Cost ($)	**$12,188,274,583**	**($838.00)**
Value of Statistical Life ($)	**$65,403,360,000**	**($4,496.71)**

Figure 1: Direct and Indirect Costs by Injury Indicator, 2019



The total VSL was over $65 billion; including the total cost of injury was $77.6 billion. To provide an example of the VSL in a cost-benefit use, we divide the willingness-to-pay for a small risk change by the risk change itself. The VSL in Canada is estimated at $650.00 per person.[10] Each person in Canada; therefore, is willing to pay 650 dollars into a policy that would reduce the risk of mortality by 1 in 10,000 statistical lives.

Unintentional and Intentional Injury

Unintentional injuries made up the majority of the total number of injuries in Ontario. These injuries included falls, unintentional poisonings, motor vehicle collisions, other unintentional injuries, drowning, fire/burn injuries, and sport-related injuries (struck by and against and falls from skates, skis, boards and blades). There was a total of 6,297 deaths, 93,626 hospitalizations, 1,420,060 ED visits and 20,834 cases of total disability. Unintentional injuries made up 76% of all deaths, 92% of all hospitalizations, 96% of all ED visits and 92% of disabilities.

Intentional injuries made up 22% of all deaths (n=1,777); 7% of total hospitalized cases (n=7,270), 4% of ED visits (n=53,050) and 7% (n=1,569) of total disability cases. These injuries included violence and self-harm/suicide. These values are presented in Table 3, in addition to the number of injuries of undetermined intent which made up 2% of death cases, and less than 1% across hospitalized, ED and disability cases.

Table 3: Number of Injury Deaths, Hospitalizations, Emergency Department (ED) Visits, Total Disability in Ontario in 2019 by Injury Intent

Intent	Deaths	Hospitalizations	ED visits	Total disability
Unintentional	6,297	93,725	1,420,060	20,834
Intentional	1,777	7,270	53,050	1,569
Undetermined intent/Other	184	998	7,475	218
Total (Rate/100,000)	**8,258 (56.8)**	**101,894 (700.6)**	**1,480,585 (10,179.5)**	**22,621 (155.5)**

The rate of injury deaths was 56.8 per 100,000 population in Ontario. The annual hospitalization rate was estimated at 700.6 per 100,000, 10,179.5 per 100,000 for ED visits, and 155.5 per 100,000 for total disability (Table 3).

The cost associated with unintentional injury was higher than the total costs of intentional injuries. This is not surprising given the frequency of injuries across intent. Unintentional injuries cost Ontario 10.3 billion dollars (96% of the total cost of injury); $7.2 billion in direct injury cost and $3.1 billion in indirect costs. Injuries of undetermined intent cost $178.1 million; 42.6 million in direct costs and 135.5 in indirect costs. The cost of undetermined injuries represented 1.4% of the total cost of injury in 2019.

Table 4: Total Cost, Direct and Indirect Cost by Injury Intent in Ontario, 2019

Intent	Total Costs	Direct Costs	Indirect Costs
Unintentional	$10,287,576,819	$7,206,746,791	$3,080,830,027
Intentional	$1,722,599,703	$319,454,997	$1,403,144,706
Undetermined Intent/Other	$178,098,060	$42,591,945	$135,506,115
Total	**$12,188,274,583**	**$7,568,793,735**	**$4,619,480,849**

Injury by Mechanism

The highest number of deaths, hospitalizations, ED visits, and total disability cases due to injury resulted from falls (Table 5). There were over 3,000 deaths, 50,000 hospitalizations and nearly half a million ED visits due to a fall-related injury in 2019. Further, there were over 14,000 people in Ontario left permanently disabled. Following falls, the other leading mechanisms of injury included other unintentional injuries, transport-related injuries, unintentional poisoning, violence and suicide/self-harm.

The economic cost was highest for other unintentional injuries ($3.8 billion), followed by falls ($3.3 billion). Table 6 reports the total cost and cost by mechanism of injury. Falls accounted for 27% of total costs (36% of direct costs and 10% of indirect costs). The total cost of falls was higher for females over males ($1,753,632,016 and $1,596,038,713 respectively), likely reflecting the higher number of falls among older adult females (ages 65 years and over) (Table 7). When examining falls by specific fall mechanism, falls on the same level represented the highest cost of falls (excluding “other falls”), accounting for 29% of total fall costs. The per patient cost due to fall hospitalizations in 2019 was $32,874 and $2,262.40 per ED visit.

The second highest cost by injury mechanism (excluding “other unintentional injuries”) was unintentional poisoning. There were 1,809 deaths, 3,958 hospitalizations, 28,109 ED visits and 1,105 injury-related disabilities in 2019. Unintentional poisoning costs were higher for males compared to females (Table 8). Males represented 71% of the total cost of unintentional poisoning injuries with the majority of cases in those ages 20–64 years of age ($1.07 billion of $1.6 billion) (Table 8). The per patient cost for hospitalizations due to unintentional poisoning was $15,782.92 and $1,086.18 per ED visit.

There were 120,187 presentations to hospital for a transport-related injury in 2019, of which, 835 resulted in death (Table 5). These injuries accounted for 11% of the total injury costs at over $1.3 billion. Injuries involving motor vehicles represented the highest cost of transport-related injury (Table 6), followed by injuries to pedestrians and cyclists. Males demonstrated higher costs of injury, across all transport-related injury mechanisms compared to females, representing 66% of total transport-related injury costs (Table 9). Further, males ages 20–64 represented 51% of the total cost of all transport-related injury combined ($677 million of $1.3 billion) (Table 9). The per patient hospitalization costs due to transport was $13,099.12 and $901.48 per ED visit.

Table 5: Number of Injury Deaths, Hospitalizations, Emergency Department (ED) Visits and Total Disability, by Injury Mechanism

Injury Mechanism	Deaths	Hospitalizations	ED Visits	Total Disability
Falls	**3,003**	**52,207**	**495,589**	**14,023**
On the same level	259	15,752	188,273	4,464
From skates, skis, boards, blades	4	688	24,160	170
From furniture	219	3,215	29,188	878
In playgrounds	0	659	12,934	151
On stairs	228	4,504	55,766	1,103
From ladders/scaffolding	20	1,024	8,824	255
Diving	0	32	1,086	8
Other	2,273	26,333	175,358	6,995
Other Unintentional Injuries	**472**	**28,481**	**740,258**	**3,747**
Transport	**835**	**7,811**	**111,541**	**1, 768**
Pedestrian	170	1,020	6,744	228
Cyclist	23	1,076	21,167	244
Motor vehicle	392	4,483	67,329	1,017
Three-wheel, ATV, snowmobile	35	713	7,105	159
Other	215	519	9,196	120
Unintentional Poisoning	**1,809**	**3,958**	**28,109**	**1,105**
Violence	**244**	**1,988**	**33,815**	**358**
Suicide/Self Harm	**1,533**	**5,272**	**19,235**	**1,212**
Suicide/Self-Harm - Poisoning	306	4,574	13,615	1,116
Suicide/Self-Harm - Other	1,227	698	5,620	96
Struck By/Against Sports Equipment	**0**	**133**	**26,882**	**25**
Fire/Burns	54	937	17,052	161
Undetermined Intent/Other	**184**	**998**	**7,475**	**218**
Drowning	**124**	**99**	**629**	**5**
Total	**8,258**	**101,894**	**1,480,585**	**22,621**

Table 6: Cost of Injury Deaths, Hospitalizations, Emergency Department (ED) Visits and Total Disability, by Injury Mechanism

Injury Mechanism	Deaths	Hospitalizations	ED Visits	Total Disability	Total
Other Unintentional Injuries	**$121,259,910**	**$908,827,582**	**$2,456,052,392**	**$300,527,023**	**$3,786,666,906**
Falls	**$206,534,800**	**$1,336,191,901**	**$1,089,739,662**	**$689,148,681**	**$3,321,615,042**
On the same level	$12,271,636	$369,098,322	$379,879,318	$184,888,709	$946,137,984
From skates, skis, boards, blades	$2,311,239	$8,835,551	$31,994,173	$37,863,594	$81,004,556
From furniture	$10,229,873	$93,043,465	$68,500,712	$49,097,167	$220,871,216
In playgrounds	$0	$5,543,428	$12,919,817	$54,864,832	$73,328,076
On stairs	$38,046,139	$114,544,727	$125,481,281	$63,140,124	$341,212,271
From ladders/ scaffolding	$8,840,629	$22,036,840	$19,263,363	$19,946,758	$70,087,591
Diving	$0	$2,069,665	$3,831,223	$1,749,639	$7,650,526
Other	$134,835,284	$721,019,903	$447,869,775	$277,597,858	$1,581,322,819
Unintentional Poisoning	**$1,415,764,988**	**$74,639,408**	**$69,796,000**	**$47,984,479**	**$1,608,184,876**
Transport	**$493,267,611**	**$239,979,095**	**$343,838,432**	**$257,636,251**	**$1,334,721,389**
Pedestrian	$87,094,516	$41,416,060	$28,774,694	$30,131,272	$187,416,542
Cyclist	$17,225,958	$22,286,345	$45,814,579	$38,892,073	$124,218,954

Injury Mechanism	Deaths	Hospitalizations	ED Visits	Total Disability	Total
Motor vehicle	$214,743,563	$148,507,958	$233,042,681	$131,888,210	$728,182,412
Three-wheel, ATV, snowmobile	$32,263,123	$15,213,083	$14,921,221	$28,967,485	$91,364,911
Other	$141,940,453	$12,555,649	$21,285,257	$27,757,211	$203,538,569
Suicide/Self Harm	**$1,134,326,073**	**$92,845,685**	**$51,994,831**	**$20,459,062**	**$1,299,625,650**
Suicide/self-harm - poisoning	$200,357,708	$68,182,383	$31,315,415	$3,344,955	$303,200,461
Suicide/self-harm - other	$933,968,365	$24,663,301	$20,679,415	$17,114,107	$996,425,188
Violence	**$224,233,379**	**$48,979,810**	**$87,114,100**	**$62,646,764**	**$422,974,053**
Undetermined Intent/Other	**$132,642,406**	**$19,631,233**	**$19,795,159**	**$6,029,262**	**$178,098,060**
Fire/Burns	**$24,888,562**	**$29,175,382**	**$29,667,434**	**$23,759,072**	**$107,490,449**
Drowning	**$88,615,040**	**$2,059,858**	**$1,743,508**	**$773,535**	**$93,191,941**
Struck By/Against Sports Equipment	**$4,188**	**$1,351,879**	**$28,946,931**	**$5,403,215**	**$35,706,214**
Total	**$3,841,536,957**	**$2,753,681,834**	**$4,178,688,448**	**$1,414,367,344**	**$12,188,274,583**

Table 7: Total Costs of Fall-related Injury, by Mechanism, Age and Sex at Birth

Injury Mechanism	Females (Per Capita)	Males (Per Capita)
On the same level	$553,015,596	$393,122,389
On stairs	$161,978,146	$179,234,125
From furniture	$122,430,636	$98,440,581
In playgrounds	$35,450,468	$37,877,608
From skates, skis, boards, blades	$28,395,600	$52,608,956
From ladders/scaffolding	$9,611,006	$60,476,585
Diving	$982,011	$6,668,514
Other	$831,450,866	$749,871,953
0–4 years	$57,102,472 ($162.69)	$192,079,443 ($519.11)
5–9 years	$56,396,824 ($150.74)	$65,955,404 ($169.61)
10–14 years	$33,722,118 ($87.29)	$49,413,708 ($123.31)
15–19 years	$25,777,257 ($61.59)	$35,803,933 ($81.10)
20–24 years	$32,167,393 ($65.50)	$43,319,036 ($80.22)
25–64 years	$487,373,853 ($122.93)	$634,825,640 ($162.54)
65–74 years	$236,533,460 ($315.97)	$212,879,932 ($314.97)
75–84 years	$357,951,525 ($860.80)	$242,673,992 ($711.88)
85+ years	$456,289,426 (2,169.87)	$216,718,737 ($1,792.68)
Total	**$1,743,314,329**	**$1,578,300,714**

Table 8: Total Costs of Unintentional Poisoning Injury, by Age and Sex at Birth

Injury Mechanism	Females (Per Capita)	Males (Per Capita)
0–14 years	$17,036,524 ($15.33)	$14,912,234 ($12.86)
15–19 years	$16,746,365 ($40.01)	$36,875,901 ($83.53)
20–24 years	$59,676,000 ($121.51)	$133,010,834 ($246.31)
25–64 years	$365,627,040 ($92.22)	$935,597,363 ($239.55)
65+ years	$14,512,996 ($10.56)	$14,189,620 ($12.47)
Total	**$473,598,925 ($64.34)**	**$1,134,585,951 ($157.93)**

Table 9: Total Cost of Transport-related Injuries, by Mechanism, Age and Sex at Birth

Injury Mechanism	Females	Males
Motor vehicle	$259,718,552	$468,463,860
Pedestrian	$75,640,687	$111,775,856
Cyclist	$34,247,227	$89,971,727
ATV, snowmobile, three-wheel	$13,705,010	$77,659,901
Other	$71,464,876	$132,073,693
0–4 years	$12,227,021 ($34.84)	$14,501,979 ($39.19)
5–9 years	$9,587,822 ($25.63)	$11,115,943 ($28.59)
10–14 years	$14,647,320 ($37.91)	$31,227,977 ($77.93)
15–19 years	$49,590,868 ($118.49)	$88,789,218 ($201.12)
20–24 years	$66,111,357 ($134.61)	$152,296,242 ($282.03)
25–64 years	$253,881,410 ($64.04)	$524,820,698 ($134.38)
65+ years	$48,730,554 ($35.45)	$57,192,465 ($50.27)
Total	**$454,776,351 ($61.79)**	**$879,945,037 ($122.48)**

Injury by Age Group

The cost of injury varies by age and injury mechanism (Table 10). The highest cost of injury among children ages 0–14 years was due to falls (excluding "other unintentional injuries") (Table 10). The total direct and indirect costs due to falls for this age group was $350,123,992 in 2019. Second to falls was transport-related injuries at $93,308,062. For youth ages 15–19, self-harm represented the leading cost of injury (excluding "other unintentional injuries"), followed by transport-related injuries at over $138 million. For adults ages 20–64 years of age, unintentional poisoning was associated with the highest cost of injury (excluding "other unintentional injuries"), followed by falls and self-harm. For older adults ages 65 and over, fall-related injuries represented the highest cost of all injury mechanisms.

Table 10: Total Costs by Injury Mechanism and Age Group

Injury Mechanism	0–14 years	15–19 years	20–64 years	65+ years	Total
Other Unintentional	$450,492,053	$183,266,803	$2,199,158,906	$953,749,144	**$3,786,666,906**
Falls	$339,300,858	$61,581,189	$1,197,685,923	$1,723,047,072	**$3,321,615,042**
Unintentional Poisoning	$31,948,758	$53,622,266	$1,493,911,237	$28,702,615	**$1,608,184,876**
Transport	$93,308,062	$138,380,085	$997,109,707	$105,923,535	**$1,334,721,389**
Self-Harm	$31,118,785	$161,821,284	$1,091,526,189	$15,159,392	**$1,299,625,650**
Violence	$34,781,249	$54,602,028	$323,783,666	$9,807,111	**$422,974,054**
Undetermined	$12,462,504	$11,002,961	$149,522,810	$5,109,786	**$178,098,061**
Fire/Burns	$19,402,088	$3,890,529	$71,394,667	$12,803,165	**$107,490,449**
Drowning	$22,240,260	$5,154,170	$64,971,669	$825,841	**$93,191,941**
Struck by/against sport equipment	$11,302,048	$5,776,073	$18,075,278	$552,814	**$35,706,214**
Total	**$1,046,356,666**	**$679,097,389**	**$7,607,140,052**	**$2,855,680,476**	**$3,349,670,730**

Preventable Injury is Increasing

The values presented in this report allow researchers and practitioners to compare the frequency, severity, and cost of injury over time. The last cost of injury in Ontario study, using data from 2010, reported the same indicators used in this report (where applicable). From 2010 to 2019, injury has increased significantly. The number of deaths increased from 5,785 to 8,258, representing a 30% absolute increase in 9 years. Hospitalizations also increased 30% from 2010 to 2019; ED visits and the number of disabilities increased approximately 10%, and the total cost of injury has increased 28% from $8.8 billion to $12.2 billion (Table 11).

Note: slight differences in methodology in this report that included additional costs that were not considered in the previous report (e.g., direct death costs, physician costs, ambulance costs, out of hospital drug costs, etc.)

Table 11: Number and Percent Change in Injury Indicators, 2010 to 2019

Injury Indicator	2010 Number, (Per Capita)	2019 Number (Per Capita)	% Change (Per Capita)
Deaths	5,785	8,258	30%
Hospitalizations	72,289	101,894	29%
Emergency Department Visits	1,350,611	1,480,585	9%
Disabilities	20,116	22,621	11%
Total Costs ($)	**8.8 billion (667)**	**12.2 billion (838)**	**28% (20%)**

The highest costing mechanism of injury in 2019, (other than “other unintentional injury”) falls, increased from $2.8 billion in 2010 to $3.3 billion in 2019. This represents a 16% increase. Increases were demonstrated across all mechanisms of injury except for fire/burn injuries which decreased from $124,000,000 to $107,490,449. Self-harm associated with poisoning decreased from $452,000,000 in 2010 to 303,200,461 in 2019; however, self-harm overall increased from $895,000,000 to $1.3 billion. Of all increases, falls and unintentional poisoning injuries make up the largest proportion of the 3.4 billion dollar increase in total injury costs from 2010 to 2019. Unintentional poisoning increased from $494 million to over $1.6 billion in 9 years.

Strengths and Limitations

There are several strengths to this work. This is the first cost of injury report in Ontario in close to a decade. Second, the data sources used in this analysis are population representative data sources. This increases our confidence in reporting the true number of injuries and deaths due to injury that present to hospitals in Ontario. In addition to routinely collected epidemiologic data that demonstrate injury-related ED visits, hospitalizations and deaths are substantial public health problems, estimation of the cost-effectiveness associated with evidence-based injury prevention strategies is needed.[11] This information, in addition to the cost of injury, can be used by decision-makers on how best to utilize a finite amount of resources for maximum benefit to society.[11]

There are; however, several limitations to this work. We acknowledge the data used in this report is dated (i.e., 2019). Complete data from 2021 were available to be used to estimate more recent injury rates in Ontario; however, these data are likely affected by the COVID-19 pandemic resulting in a fewer number of reported injuries. This phenomenon has been noted widely in the research literature across health outcomes and specifically for injury.[12,13] Data from 2019 were used to represent a more accurate number of injuries that occur annually in Ontario. Second, the estimates presented in this report should be considered conservative given data on the impact on individuals and both acute clinic and physician visits were not included in the cost calculations. Third, the costing in this report is reliant on ICD-10 CA coding used in each data source (i.e., NACRS, DAD and VS). This coding is inputted by practitioners at each local hospital and trauma centre across Ontario; thus, potentially subject to coding discrepancies. The most significant consequence of this limitation is the number of injuries coded as “other unintentional injuries”. Increased specificity in the coding of injuries would increase our understanding of the true cost of each injury mechanism. Finally, this report could benefit from a more detailed analysis of the underlying factors that could contribute to the increase in injury costs (other than the increase in injury numbers across the province), as well as the effectiveness of current prevention programs. Future work should include a cost savings analysis from implementation of an evidence-based intervention as a case study or example from a municipality or public health unit to provide practical insights for practitioners and decision-makers.

Conclusions

This report demonstrates the significant economic burden of injury in Ontario. The information presented in this report can be used by public health to establish priorities for prevention initiatives. Providing both the direct and indirect costs by injury mechanism, age, and sex are essential, in addition to the estimation of the cost-effectiveness associated with evidence-based injury prevention strategies. This is the first costing report in nearly a decade, providing practitioners with up-to-date information on the cost of injury, by injury mechanism, age and sex. Priority areas include reducing hospitalizations and ED visits for fall-related injuries among those ages 65+ years and efforts to reduce unintentional poisonings among those 20–64 and injury due to self-harm among those ages 15–19. The estimates presented in this report draw attention to the need to reduce the burden of injury in Ontario. This can and should be done with efforts to prioritize on-going surveillance and research in injury prevention.

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Appendix A: ICD-10 CA Codes

The following lists the ICD-10 CA codes by injury mechanism:

Unintentional Injuries

- Motor Vehicle Collisions – Pedestrians: V01 - V09
- Motor Vehicle Collisions – Cyclists: V10 - V19
- Motor Vehicle Collisions – Motor Vehicles: V20 - V29, V40 - V79
- Motor Vehicle Collisions – Three-wheel, ATV, Snowmobile: V30 - V39, V86
- Motor Vehicle Collisions – Other: V80 - V85, V87 - V89, V91, V93 - V99
- Falls – On Same Level: W00 - W01
- Falls – From Skates, Skis, Boards, Blades: W02
- Falls – From furniture: W06 - W08
- Falls – In playgrounds: W09
- Falls – On Stairs: W10
- Falls – From Ladders/Scaffolding: W11 - W12
- Falls – Diving: W16
- Falls – Other: W03 - W05, W13 - W15, W17 - W19
- Drowning: V90, V92, W65 - W74
- Fire/Burns: X00 - X19
- Unintentional Poisoning: X40 - X49
- Struck by/against Sports Equipment: W21
- Other Unintentional Injuries: W20, W22 - W64, W75 - W99, X20 - X39, X50, X58, X59

Intentional Injuries

- Suicide/Self-Harm – Poisoning: X60 - X69
- Suicide/Self-Harm – Other: X70 - X84
- Violence: X85 - X99, Y00 - Y09
- Undetermined Intent/Other: Y10 – Y36

Appendix B: Direct, Indirect and Total Costs of Injury by Injury Indicator

Table B1: Direct, Indirect and Total costs of Injury Deaths, by Injury Mechanism

Injury Mechanism	Direct Costs	Indirect Costs	Total
Unintentional Poisoning	**$15,667,773**	**$1,400,097,215**	**$1,415,764,988**
Suicide/Self Harm	**$13,319,151**	**$1,121,006,922**	**$1,134,326,074**
Suicide/Self-Harm - Poisoning	$2,671,628	$197,686,080	$200,357,708
Suicide/Self-Harm - Other	$10,647,523	$923,320,842	$933,968,366
Transport	**$8,090,386**	**$485,177,225**	**$493,267,611**
Pedestrian	$1,790,060	$85,304,456	$87,094,516
Cyclist	$441,536	$16,784,422	$17,225,957
Motor vehicle	$3,480,121	$211,263,442	$214,743,563
Three-wheel, ATV, snowmobile	$345,342	$31,917,781	$32,263,123
Other	$2,033,329	$139,907,124	$141,940,453
Falls	**$25,074,068**	**$181,460,731**	**$206,534,799**
On the same level	$2,528,561	$9,743,075	$12,271,635
From skates, skis, boards, blades	$62,837	$2,248,402	$2,311,238
From furniture	$1,985,733	$8,244,140	$10,229,873
In playgrounds	$0	$0	$0
On stairs	$2,071,709	$35,974,430	$38,046,139
From ladders/ scaffolding	$570,786	$8,269,843	$8,840,629
Diving	$0	$0	$0
Other	$17,854,442	$116,980,842	$134,835,284
Violence	**$2,236,083**	**$221,997,296**	**$224,233,379**
Undetermined Intent/Other	**$1,752,889**	**$130,889,517**	**$132,642,406**

Injury Mechanism	Direct Costs	Indirect Costs	Total
Other Unintentional Injuries	**$9,287,638**	**$111,972,272**	**$121,259,910**
Drowning	**$1,153,366**	**$87,461,674**	**$88,615,040**
Fire/Burns	**$828,500**	**$24,060,062**	**$24,888,562**
Struck By/Against Sports Equipment	**$4,188**	**$0**	**$4,188**
Total	**$77,414,043**	**$3,764,122,914**	**$3,841,536,957**

Table B2: Direct, Indirect and Total Costs of Injury Hospitalizations, by Injury Mechanism

Injury Mechanism	Direct Costs	Indirect Costs	Total
Falls	**$1,301,202,583**	**$34,989,318**	**$1,336,191,901**
On the same level	$358,827,010	$10,271,312	$369,098,322
From skates, skis, boards, blades	$8,059,566	$775,985	$8,835,551
From furniture	$90,890,737	$2,152,728	$93,043,465
In playgrounds	$4,671,818	$871,610	$5,543,428
On stairs	$111,266,682	$3,278,045	$114,544,727
From ladders/ scaffolding	$21,118,694	$918,146	$22,036,840
Diving	$1,997,606	$72,059	$2,069,665
Other	$704,370,470	$16,649,433	$721,019,903
Other Unintentional Injuries	**$890,548,766**	**$18,278,816**	**$908,827,582**
Transport	**$230,190,591**	**$9,788,503**	**$239,979,094**
Pedestrian	$40,048,782	$1,367,278	$41,416,060
Cyclist	$21,057,944	$1,228,401	$22,286,345
Motor vehicle	$142,901,852	$5,606,106	$148,507,958
Three-wheel, ATV, snowmobile	$14,360,995	$852,088	$15,213,083
Other	$11,821,018	$734,630	$12,555,648

Injury Mechanism	Direct Costs	Indirect Costs	Total
Suicide/Self Harm	**$90,289,907**	**$2,555,778**	**$92,845,685**
Suicide/Self-Harm - Poisoning	$66,502,240	$1,680,143	$68,182,383
Suicide/Self-Harm - Other	$23,787,667	$875,634	$24,663,301
Unintentional Poisoning	**$72,961,825**	**$1,677,584**	**$74,639,409**
Violence	**$46,799,611**	**$2,180,199**	**$48,979,810**
Fire/Burns	**$28,234,582**	**$940,800**	**$29,175,382**
Undetermined Intent/Other	**$19,093,358**	**$537,875**	**$19,631,233**
Drowning	**$2,009,159**	**$50,699**	**$2,059,858**
Struck By/Against Sports Equipment	**$1,246,674**	**$105,205**	**$1,351,879**
Total	**$2,682,577,057**	**$71,104,777**	**$2,753,681,834**

Table B3: Direct, Indirect and Total Costs of Injury Emergency Department Visits, by Injury Mechanism

Injury Mechanism	Direct Costs	Indirect Costs	Total
Other Unintentional Injuries	**$2,456,032,642**	**$19,750**	**$2,456,052,392**
Falls	**$1,089,728,681**	**$10,980**	**$1,089,739,662**
On the same level	$379,875,991	$3,327	$379,879,318
From skates, skis, boards, blades	$31,993,996	$177	$31,994,173
From furniture	$68,500,167	$545	$68,500,712
In playgrounds	$12,919,670	$146	$12,919,817
On stairs	$125,479,611	$1,670	$125,481,281
From ladders/scaffolding	$19,262,599	$764	$19,263,363
Diving	$3,831,223	$0	$3,831,223
Other	$447,865,424	$4,351	$447,869,775

Injury Mechanism	Direct Costs	Indirect Costs	Total
Transport	**$343,815,007**	**$23,425**	**$343,838,432**
Pedestrian	$28,773,328	$1,367	$28,774,694
Cyclist	$45,813,438	$1,141	$45,814,579
Motor vehicle	$233,024,247	$18,434	$233,042,681
Three-wheel, ATV, snowmobile	$14,920,301	$919	$14,921,221
Other	$21,283,693	$1,564	$21,285,257
Violence	**$87,110,412**	**$3,688**	**$87,114,100**
Unintentional Poisoning	**$69,100,667**	**$695,333**	**$69,796,000**
Suicide/Self Harm	**$51,934,033**	**$60,798**	**$51,994,831**
Suicide/Self-Harm - Poisoning	$31,256,369	$59,046	$31,315,415
Suicide/Self-Harm - Other	$20,677,664	$1,752	$20,679,415
Fire/Burns	**$29,648,832**	**$18,602**	**$29,667,434**
Struck By/Against Sports Equipment	**$28,946,931**	**$0**	**$28,946,931**
Undetermined Intent/Other	**$19,776,361**	**$18,797**	**$19,795,159**
Drowning	**$1,743,508**	**$0**	**$1,743,508**
Total	**$4,177,837,075**	**$851,374**	**$4,178,688,448**

Table B4: Direct, Indirect and Total Costs of Injury-related Disabilities, by Injury Mechanism

Injury Mechanism	Direct Costs	Indirect Costs	Total
Falls	**$358,572,561**	**$330,576,120**	**$689,148,681**
On the same level	$104,507,880	$80,380,829	$184,888,709
From skates, skis, boards, blades	$13,244,980	$24,618,614	$37,863,594
From furniture	$24,919,846	$24,177,321	$49,097,167
In playgrounds	$19,704,142	$35,160,690	$54,864,832
On stairs	$31,918,897	$31,221,228	$63,140,125

Injury Mechanism	Direct Costs	Indirect Costs	Total
From ladders/scaffolding	$9,139,449	$10,807,309	$19,946,758
Diving	$587,296	$1,162,342	$1,749,638
Other	$154,550,072	$123,047,786	$277,597,858
Other Unintentional Injuries	**$126,379,756**	**$174,147,267**	**$300,527,023**
Transport	**$93,575,014**	**$164,061,236**	**$257,636,250**
Pedestrian	$11,319,306	$18,811,967	$30,131,273
Cyclist	$14,121,156	$24,770,917	$38,892,073
Motor vehicle	$48,782,970	$83,105,240	$131,888,210
Three-wheel, ATV, snowmobile	$10,005,947	$18,961,538	$28,967,485
Other	$9,345,636	$18,411,575	$27,757,211
Violence	**$20,927,405**	**$41,719,359**	**$62,646,764**
Unintentional Poisoning	**$11,725,254**	**$36,259,225**	**$47,984,479**
Fire/Burns	**$8,905,246**	**$14,853,826**	**$23,759,072**
Suicide/Self Harm	**$6,838,395**	**$13,620,667**	**$20,459,062**
Suicide/Self-Harm - Poisoning	$1,019,239	$2,325,716	$3,344,955
Suicide/Self-Harm - Other	$5,819,156	$11,294,951	$17,114,107
Undetermined Intent/Other	**$1,969,337**	**$4,059,925**	**$6,029,262**
Struck By/Against Sports Equipment	**$1,789,239**	**$3,613,976**	**$5,403,215**
Drowning	**$283,352**	**$490,183**	**$773,535**
Total	**$630,965,560**	**$783,401,784**	**$1,414,367,344**

Public Health Ontario
661 University Avenue, Suite 1701
Toronto, Ontario
M5G 1M1
416.235.6556
communications@oahpp.ca
publichealthontario.ca

Ontario