

# Canadian Substance Use Costs and Harms

2007–2014



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# CSUCH Canadian Substance Use Costs and Harms

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# Executive Summary



## Executive Summary

In 2014, the cost of substance use (SU) in Canada was \$38.4 billion— or approximately \$1,100 spent for every Canadian regardless of age.<sup>1</sup> This report presents the estimates of the costs of SU in Canada from 2007 to 2014 using the most reliable, up-to-date data sources and methods according to the following categories:

- Cost type (healthcare costs, lost productivity costs, criminal justice costs and other direct costs);
- Substance; and
- Province and territory.

The ability to track costs and trends in harms uniquely caused by specific types of substance will be a valuable asset to federal, provincial and territorial efforts aimed at reducing these harms. A better understanding of the societal costs associated with different substances can help inform policy decision making and resource allocation for law enforcement, and prevention, treatment and harm reduction services.

## Overall Costs of Substance Use



In 2014:

- Almost 70% of the total costs were due to alcohol and tobacco.
- The four substances associated with the largest costs were (in order):
  - Alcohol, contributing \$14.6 billion or 38.1% of the total costs;
  - Tobacco, contributing \$12.0 billion or 31.2% of the total costs;
  - Opioids, contributing \$3.5 billion or 9.1% of the total costs; and
  - Cannabis, contributing \$2.8 billion or 7.3% of the total costs.
- The distribution across the cost types was (in order):
  - Lost productivity, contributing \$15.7 billion or 40.8% of the total costs;
  - Healthcare costs, contributing \$11.1 billion or 29.0% of the total costs;
  - Criminal justice, contributing \$9.0 billion or 23.3% of the total costs; and
  - Other direct costs, contributing \$2.7 billion or 7.0% of the total costs.
- Per-person costs from SU were highest in the three territories.

<sup>1</sup> At the time of this report, the Canadian Institute for Health Information (CIHI) had not been granted permission to provide hospitalization data to the research team. Because of this, all per-person estimates do not include costs associated with inpatient hospitalization, day surgery and emergency department costs in the province of Quebec. It is expected that this led to an underestimation of approximately \$750M, or 2% of total cost. All estimates as well as per-person estimates should be considered conservative by this margin.



Between 2007 and 2014:<sup>2,3</sup>

- The per-person costs associated with SU increased 5.5% from \$1,025 per person in 2007 to approximately \$1,081 in 2014.
- The per-person costs associated with alcohol use increased 11.6% from \$369 per person in 2007 to \$412 per person in 2014.
- Per-person costs increased 19.1% for cannabis (\$67 to \$79) and 6.8% for tobacco (\$315 to \$337).
- Per-person costs decreased by 24.6% for cocaine (\$84 to \$63) and by 17.9% for other substances (\$20 to \$16).



## Healthcare-related Costs

Healthcare-related costs include inpatient hospitalizations, day surgery treatment episodes, emergency department presentations, specialist treatment for SU disorders, the costs of physician time and prescription drug costs.

In 2014:

- SU-related healthcare costs amounted to \$11.1 billion or \$345 per person in Canada.<sup>4</sup>
- Alcohol and tobacco use contributed over 90% of costs.
- After alcohol and tobacco, opioids cost the healthcare system the third-highest amount at \$313 million (2.8%).
- Over 90% of all healthcare-related costs were contributed by inpatient hospital care (26.3%), physician time (36.1%) and prescription drug costs (27.7%).
- Contributing to these costs were the 255,600 hospitalizations attributable to SU, of which 145,800 (57.0%) were from tobacco and 87,900 (34.4%) from alcohol.
- Per-person healthcare costs from SU were highest in the three territories, reflecting especially high rates of alcohol and tobacco use.

Between 2007 and 2014:

- Costs associated with SU-related health care increased 14.8% from \$273 per person in 2007 to \$313 in 2014.<sup>5</sup>
- Alcohol-related healthcare costs increased 25.9% from \$95 to \$119 per person.
- Cannabis-related healthcare costs increased 27.9% from \$5 to \$6 per person.
- Opioid-related healthcare costs increased 22.2% from \$7 to \$9 per person.

<sup>2</sup>Throughout this report, costs for all years are presented in 2014 Canadian dollars.

<sup>3</sup>All per-person estimates in this report are calculated using the entire population of Canada by year.

<sup>4</sup>Only some healthcare-related data were available for Quebec. This per-person healthcare cost was calculated without Quebec.

<sup>5</sup>Only some healthcare-related data were available for Quebec. These national per-person trend estimates include Quebec and therefore differ from the \$345 indicated above.



## Lost Productivity Costs

Estimates of SU-related lost productivity costs were based on the lost value of work due to premature mortality, long-term disability and short-term disability (absenteeism and impaired job performance).

In 2014:

- Lost productivity costs attributable to SU in 2014 were \$15.7 billion.
- Lost productivity costs attributable to SU were approximately \$441 per person.
- Costs associated with the use of legally available substances, alcohol and tobacco, were estimated to contribute just over 75% of all lost productivity costs associated with SU.
- Contributing to these costs were 20,715 SU attributable deaths among those of working age (age < 65) and 284,324 productive years of life lost, with alcohol being the leading cause of lost productivity.

Between 2007 and 2014:

- Overall per-person lost productivity costs increased approximately 8.4% from \$406 in 2007 to \$441 in 2014.
- The largest increase in per-person lost productivity costs were associated with opioids, which increased 20.6% from \$43 per person in 2007 to \$52 per person in 2014. This increase is likely due to the increasing number of premature deaths related to opioid use.



## Criminal Justice Costs

Criminal justice costs include those associated with police work, courts and corrections. Included in our calculations are expenditures for criminal offences that are 100% attributable to SU (i.e., impaired driving and drug-related offences that fall under the *Controlled Drugs and Substances Act* [CDSA]) and criminal offences partially attributable to SU (i.e., violent offences such as homicide or assault, and non-violent offences such as theft or arson).

In 2014:

- Almost \$9 billion was spent on criminal justice associated with SU, which amounts to \$252 for every Canadian.
- 43% of partially attributable crimes (i.e., excluding impaired driving and crimes defined under the CDSA) would not have occurred if the perpetrator had not been under the influence of or seeking alcohol or other drugs.
- Almost 20% of all violent crime would not have occurred if the perpetrator was not under the influence of or seeking alcohol.
- Alcohol was responsible for the greatest costs to the criminal justice system at \$3.2 billion or 35.2% of all criminal justice costs.
- Cocaine was responsible for the second-highest SU-related crime costs (\$1.9 billion or 20.8%). Only 11% of this cost was associated with violations of the CDSA (e.g., trafficking, possession), while the other 89% were associated with other violent and non-violent crimes.
- Cannabis was responsible for the third-highest SU-related crime costs (\$1.8 billion or 19.7%), of which 60% of costs were associated with violations of the CDSA.



Between 2007 and 2014:

- Criminal justice costs decreased 6.1% from approximately \$269 per person in 2007 to about \$252 per person in 2014.
- Despite an overall decrease in crime incidents, charges and incarcerations, criminal justice spending associated with alcohol increased 6.0% (from \$84 to \$89 per person) and cannabis increased by 27.4% (from \$39 to \$50 per person).



## Other Direct Costs

Other direct costs include estimates for SU-related expenditures across several distinct categories including research and prevention, fire damage, motor vehicle damage and workplace costs not already covered in lost productivity (e.g., employee assistance programs, drug testing programs and administrative costs associated with workers' compensation).

In 2014:

- These other direct costs contributed approximately \$2.7 billion to the total SU-related cost. This amount was the equivalent of \$75 per Canadian.
- Alcohol accounted for 50% of other direct costs, followed by cannabis at about 18%.
- Almost \$1.7 billion was spent on damage to motor vehicles as a result of SU-related collisions.
- Damage to property due to SU-associated fires amounted to \$590 million.

## Implications

The Canadian Substance Use Costs and Harms Working Group suggests that these estimates provide a valuable baseline for Canada as major changes and challenges relating to patterns of SU and associated harms are under way. At the time of writing, cannabis is soon to be legalized and it will be seen whether rates of use and harms increase. Rates of cannabis use and harms are far lower than those for alcohol and tobacco and in 2014 were slightly lower than those for opioid drugs.

The year of focus, 2014, is at the very beginning of the current alarming rise in opioid overdose events in Canada. It can be expected that the associated economic costs of opioid use will increase — probably quite substantially. Canadian jurisdictions such as British Columbia and Ontario have substantially loosened restrictions on the sale of alcohol since 2014, which suggests there could be increasing alcohol-attributable harms in future estimates. There could, however, be countervailing trends depending on the extent to which increased cannabis use might substitute for the use of alcohol (Baggio, Chong, & Kwon, 2017).

In relation to tobacco use, there is increasing evidence that electronic cigarettes have been taking market share and there are grounds for supposing they will be substantially less harmful than smoked tobacco (Newton, Dockrell, & Marczylo, 2018). It will be important to monitor the extent to which individuals who currently smoke are switching to these products and how new cohorts of young people will elect to smoke tobacco versus vaping electronic cigarettes. However, recent Canadian data indicates trends of decreased use of tobacco alongside increased use of electronic cigarettes by youth (Hammond, Reid, Cole, & Leatherdale, 2017).

It will be important to monitor trends in all these major categories of SU in Canada and their related harms and costs over the years ahead. This work provides a foundation that can be built upon as more data sources become available. The estimates presented in this report will be updated annually as a support to decision makers, policy advisors and researchers.



# Introduction





## Introduction

This report presents estimates of the overall costs of substance use (SU) in Canada based on the most reliable, up-to-date data sources and methods available for the years 2007 to 2014 (the most recent year for which comprehensive data were available). In addition, it presents more specific estimates of the economic costs associated with a broad range of substances, including alcohol, tobacco, cannabis, opioids, other central nervous system (CNS) depressants (e.g., benzodiazepines, barbiturates), cocaine, other CNS stimulants (e.g., amphetamine, methamphetamine, ecstasy) and other substances (e.g., hallucinogens, inhalants). Estimates are also presented by province/territory and cost type (i.e., healthcare, productivity, criminal justice and other direct costs).

Detailed results and methods are provided in the *Canadian Substance Use Costs and Harms: Technical Report*. The technical report as well as more detailed healthcare results by province/territory, year, substance, type of harm, cost type, sex and age group will be available on the project website ([www.csuch.ca](http://www.csuch.ca)).

## Comparisons with Other Cost Studies

The estimates presented in the report are derived from the costs associated with conditions and events fully and partially attributable to SU. The work presented here draws from an international literature that has generated economic costs of SU for many countries and includes international guidelines for the conduct of such studies (Single et al., 2003). It also owes a great deal to the work conducted in previous Canadian cost studies (Rehm et al., 2006; Single, Robson, Xie, & Rehm, 1998). However, because we were able to access more comprehensive data sets and take advantage of improved analytic techniques, the estimates in this report should not be directly compared to these earlier studies.<sup>6</sup>

Nonetheless, we understand that people will feel compelled to compare these studies and will note the very similar figures arrived at by us (for 2014) and by Rehm and colleagues (for 2002) for the total costs of SU in Canada. Between 2007 and 2014, there has been an increase in both the absolute costs of SU and the costs of SU per person. We used substantially different and more conservative methods for our estimates of healthcare and lost productivity costs than Rehm and colleagues, meaning it is not possible to make a direct comparison of these costs. Our methods were, however, more comparable for criminal justice and other direct costs. In these areas we estimate a 57% increase in the costs per person between 2002 and 2014.

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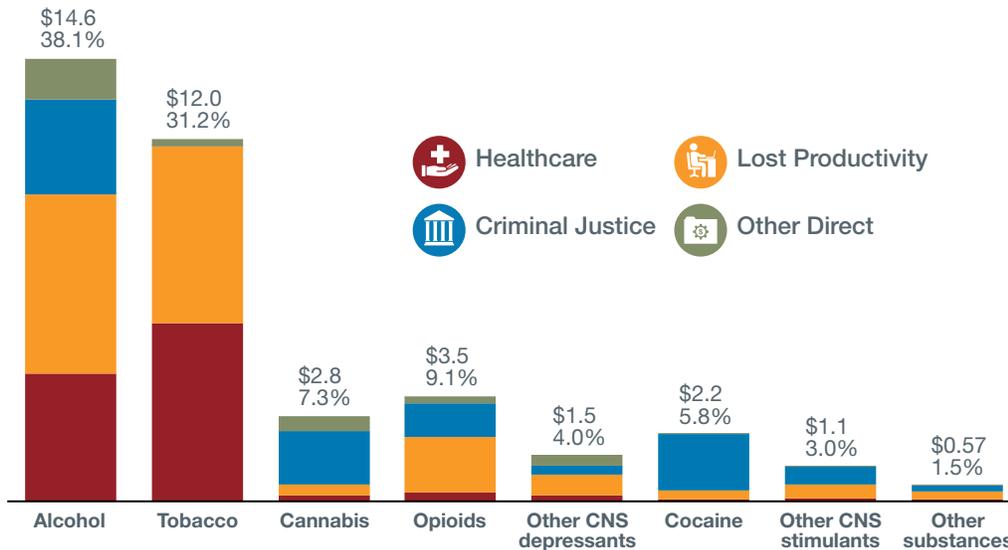
<sup>6</sup>Although this is the case across the entire report, it is especially true when assessing the costs associated with lost productivity due to SU-related long-term disability and inpatient hospitalizations.



## Overall Costs of Substance Use in Canada

The overall economic cost of SU in Canada in 2014 was estimated to be \$38.4 billion.<sup>7</sup> This estimate represents a cost of approximately \$1,100 for every Canadian regardless of age. In 2014, the legally available and most widely used psychoactive substances, alcohol and tobacco, contributed almost 70% of these costs. Alcohol accounted for about \$14.6 billion (38.1%), tobacco accounted for about \$12.0 billion (31.2%) and other substances accounted for about \$11.8 billion (30.7%) of these costs (see Figure 1 and Table 1). Among the currently illegal substances, opioids were responsible for slightly higher costs than cannabis in 2014.

**Figure 1.** Overall costs (in billions) and percentage of total overall costs attributable to substance use by substance and cost type, 2014



**Note:** These estimates do not include costs associated with inpatient hospitalization, day surgery and emergency department costs in the province of Quebec.

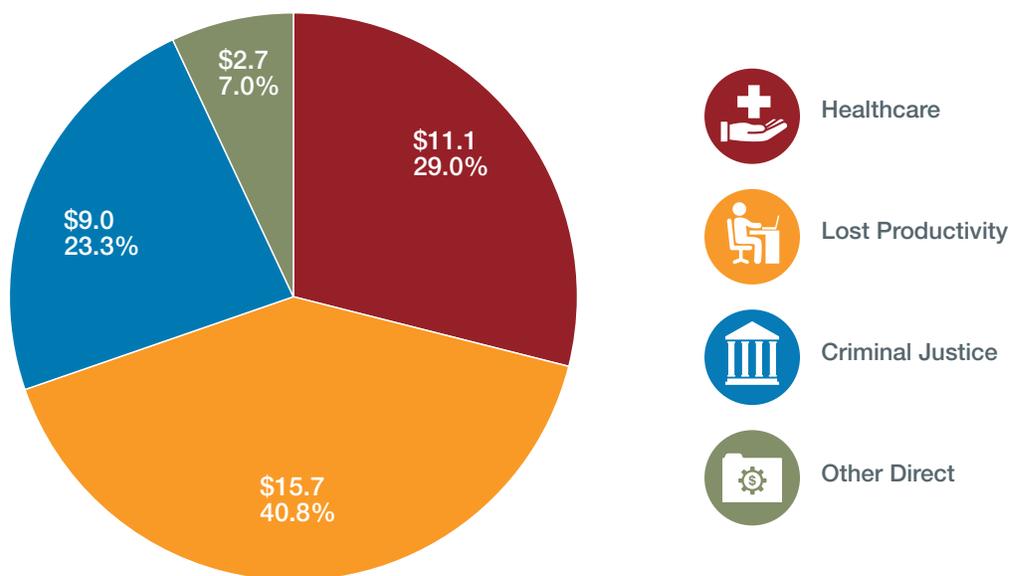
<sup>7</sup> This figure does not include costs associated with inpatient hospitalization, day surgery, and emergency department costs in the province of Quebec. A rough calculation based on Ontario per-person costs across these three cost types indicates that this accounts for an approximate \$760 million or approximately 2%. Therefore, all estimates as well as per-person estimates should be considered conservative by this margin.

Cost estimates included in this report are broken down into four major cost types:

- 
**Healthcare costs** associated with inpatient hospitalizations, day surgery treatment episodes, emergency department presentations, specialist treatment for SU disorders, the cost of physician's time and drug prescriptions;
- 
**Lost productivity costs** associated with SU-attributable premature mortality, long-term disability, absenteeism and impaired performance on the job (or "presenteeism");
- 
**Criminal justice costs** associated with policing, courts and corrections that can be attributed to SU, including costs associated with the enforcement of current drug and impaired-driving laws, as well as the impact of violent and non-violent crimes that would not have occurred without some SU; and
- 
**Other direct costs**, a heterogeneous category that includes costs associated with the federal funding of research and prevention programs, SU-attributable fire damage, motor vehicle damage, drug testing in the workplace, employee-assistance programs and workers' compensation.

The costs of SU in Canada in 2014 by cost type are presented in both Figure 2 and Table 1. Productivity losses amounted to \$15.7 billion or 40.8% of the total costs, while healthcare costs were \$11.1 billion (29.0%). The third-highest contributor to total SU-related costs was criminal justice with a cost of \$9.0 billion or 23.3% of the total.

**Figure 2.** Overall costs (in billions) and percentage of total overall costs attributable to substance use in Canada by cost type, 2014



**Total cost: \$38.4 billion**

**Table 1.** Costs attributable to substance use in Canada (in millions of dollars) in 2014

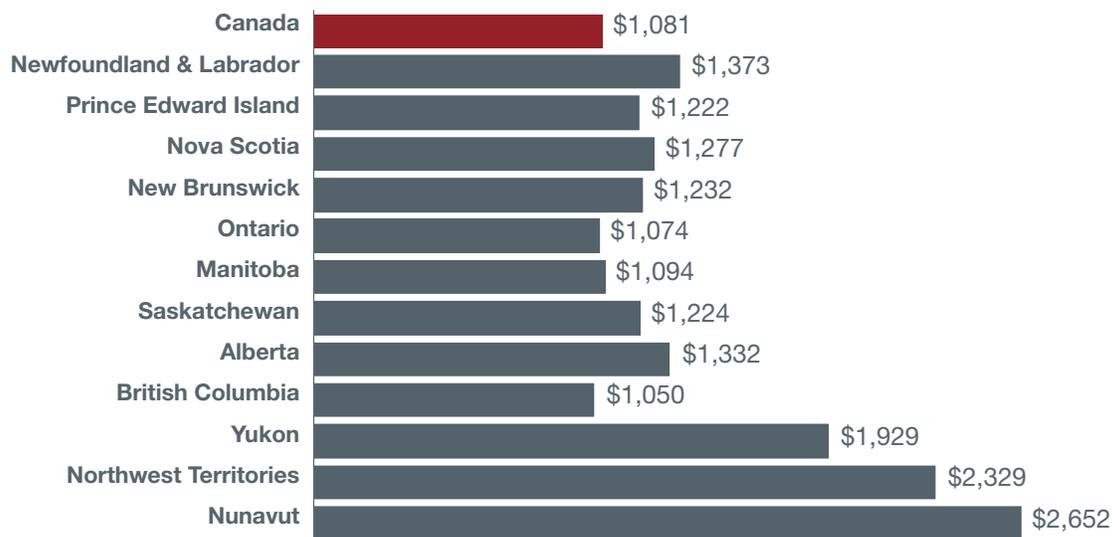
| Substance  | Alcohol         | Tobacco                | Cannabis       | Opioids        | Other CNS<br>Depressants | Cocaine        | Other CNS<br>Stimulants | Other<br>Substances | Total           |
|--|-----------------|------------------------|----------------|----------------|--------------------------|----------------|-------------------------|---------------------|-----------------|
| <b>Healthcare costs</b>                              | <b>4,230.2</b>  | <b>5,902.6</b>         | <b>208.9</b>   | <b>313.1</b>   | <b>217.3</b>             | <b>77.6</b>    | <b>107.4</b>            | <b>65.7</b>         | <b>11,122.6</b> |
| Inpatient hospitalizations                           | 1,092.4         | 1,630.8                | 38.8           | 66.2           | 49.2                     | 13.3           | 15.4                    | 17.9                | 2,923.9         |
| Day surgery  | 47.5            | 49.6                   | 0.7            | 0.3            | 0.3                      | 0.1            | 0.0                     | 0.1                 | 98.5            |
| Emergency department visits                          | 200.6           | 114.9                  | 10.7           | 12.7           | 11.0                     | 4.1            | 4.8                     | 1.8                 | 360.6           |
| Specialized SU treatment                             | 453.2           | n/a                    | 63.0           | 51.4           | 7.9                      | 23.3           | 36.6                    | 3.1                 | 638.4           |
| Physician time                                       | 1,413.3         | 2,280.0                | 55.6           | 105.3          | 86.6                     | 21.6           | 29.7                    | 24.2                | 4,016.3         |
| Prescription drugs                                   | 1,023.2         | 1,827.3                | 40.0           | 77.2           | 62.3                     | 15.3           | 20.9                    | 18.5                | 3,084.8         |
| <b>Lost productivity costs</b>                       | <b>5,916.4</b>  | <b>5,843.9</b>         | <b>368.0</b>   | <b>1,831.6</b> | <b>684.9</b>             | <b>294.1</b>   | <b>458.7</b>            | <b>261.5</b>        | <b>15,659.1</b> |
| Premature mortality                                  | 3,874.1         | 3,007.4                | 249.2          | 1,622.0        | 521.9                    | 248.0          | 395.3                   | 210.9               | 10,128.7        |
| Long-term disability                                 | 1,367.4         | 1,414.4                | 72.5           | 117.9          | 87.2                     | 29.0           | 41.5                    | 28.1                | 3,158.0         |
| Short-term disability (absenteeism and presenteeism) | 674.9           | 1,422.1                | 46.3           | 91.7           | 75.8                     | 17.1           | 21.9                    | 22.6                | 2,372.4         |
| <b>Criminal justice costs</b>                        | <b>3,154.2</b>  | <b>5.6<sup>a</sup></b> | <b>1,761.3</b> | <b>1,110.4</b> | <b>296.9</b>             | <b>1,864.5</b> | <b>575.5</b>            | <b>193.2</b>        | <b>8,961.6</b>  |
| Policing   | 1,630.5         | n/a                    | 835.2          | 639.0          | 163.6                    | 1,055.5        | 324.2                   | 109.4               | 4,757.3         |
| Courts   | 698.3           | n/a                    | 342.2          | 212.5          | 57.2                     | 359.7          | 109.6                   | 34.4                | 1,814.0         |
| Corrections  | 825.3           | n/a                    | 583.8          | 258.8          | 76.2                     | 449.3          | 141.7                   | 49.5                | 2,384.7         |
| <b>Other direct costs</b>                            | <b>1,340.3</b>  | <b>222.3</b>           | <b>480.5</b>   | <b>233.6</b>   | <b>341.3</b>             | <b>6.5</b>     | <b>7.4</b>              | <b>50.9</b>         | <b>2,682.8</b>  |
| Research and prevention                              | 66.4            | 72.3 <sup>a</sup>      | 10.6           | 14.4           | 10.6                     | 1.7            | 1.5                     | 19.8                | 197.4           |
| Fire damage  | 430.4           | 150.0                  | 10.0           | n/a            | n/a                      | n/a            | n/a                     | n/a                 | 590.4           |
| Motor vehicle damage                                 | 715.1           | n/a                    | 430.5          | 198.5          | 311.1                    | 2.5            | 2.9                     | 28.9                | 1,689.5         |
| Workplace drug testing                               | 7.5             | n/a                    | 6.1            | 7.1            | 4.6                      | 0.6            | 0.9                     | 0.6                 | 27.3            |
| Employee-assistance programs                         | 51.1            | n/a                    | 3.3            | 4.8            | 0.9                      | 1.7            | 1.9                     | 0.2                 | 63.9            |
| Workers' compensation administrative costs           | 69.7            | n/a                    | 20.0           | 8.9            | 14.1                     | 0.1            | 0.2                     | 1.3                 | 114.3           |
| <b>Total</b>   | <b>14,641.1</b> | <b>11,974.3</b>        | <b>2,818.7</b> | <b>3,488.6</b> | <b>1,540.4</b>           | <b>2,242.7</b> | <b>1,149.0</b>          | <b>571.2</b>        | <b>38,426.1</b> |
| <b>Total cost per person (in dollars)</b>            | <b>412.02</b>   | <b>336.97</b>          | <b>79.32</b>   | <b>98.17</b>   | <b>43.35</b>             | <b>63.11</b>   | <b>32.33</b>            | <b>16.07</b>        | <b>1,081.35</b> |
| <b>% of all SU-related costs</b>                     | <b>38.1%</b>    | <b>31.2%</b>           | <b>7.3%</b>    | <b>9.1%</b>    | <b>4.0%</b>              | <b>5.8%</b>    | <b>3.0%</b>             | <b>1.5%</b>         | <b>100%</b>     |

**Note:** <sup>a</sup> Costs are limited to federal spending on tobacco control and enforcement. Federal spending on tobacco-related prevention efforts are captured in the research and prevention costs for tobacco.



In 2014, the per-person economic costs were estimated to be higher in the territories than the provinces, reflecting in particular their higher rates of tobacco smoking and alcohol use and higher cost of health care delivery (Figure 3).

**Figure 3.** Overall per person costs attributable to substance use by province and territory, 2014



**Note:** Meaningful per-person costs for Quebec could not be calculated.

## Trends in Economic Costs from 2007 to 2014

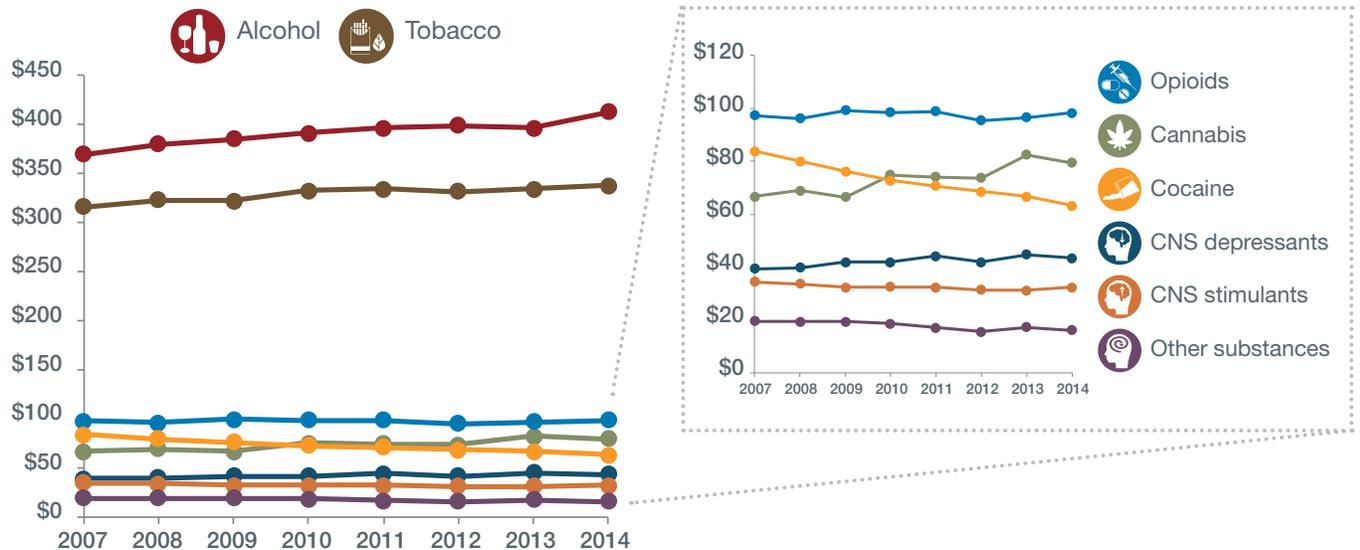
The cost of SU in Canada has increased approximately 14% from \$33.7 billion in 2007 to \$38.4 billion in 2014.<sup>8</sup> However, the Canadian population has also increased over that time. The per-person economic costs of SU in Canada increased by 5.5% from \$1,025 per person in 2007 to \$1,081 in 2014.

Over our study period, the per-person costs associated with alcohol use increased 11.6% from \$369 per person in 2007 to \$412 per person in 2014 (Figure 4). Other per-person cost increases were found in relation to the use of other CNS depressants (10.0%), tobacco (6.8%) and opioids (0.9%). However, the largest per-person increase was associated with cannabis costs, which grew by 19.1% from \$67 per person in 2007 to \$79 per person in 2014 (Figure 4). However, it is important to note that, compared with alcohol, the per-person costs for cannabis were still less than one-quarter the per-person costs associated with alcohol across all years assessed. Also, as shown in Table 1, the bulk of the costs associated with cannabis use are estimated to flow from cannabis-related crime. In 2014, more than 60% of cannabis-related crime costs involved violations of the *Controlled Drugs and Substances Act*. It is expected that crime-related cannabis costs will decrease when it is legalized later in 2018.

<sup>8</sup> Unless otherwise noted, all cost figures presented in this report have been adjusted for inflation and are presented in 2014 dollars.



**Figure 4.** Overall per person costs (2014 CAD) attributable to substance use in Canada by substance, 2007-2014



**Note:** Due to missing Quebec data, costs are likely 1% to 2% higher than what is reported here.

## Overview of Methods

The economic costs of SU presented in this report have been assessed across four broad areas: healthcare costs, lost productivity costs, criminal justice costs and other direct costs. The present study was based on the approaches applied in other Canadian and international substance use cost studies (e.g., Collins & Lapsley, 2008). However, the availability of additional datasets and analytic resources enabled significant methodological improvements and refinements in the methods employed across a number of key areas. As a result, the estimates presented in this report should not be directly compared with those made in earlier Canadian cost studies.

Wherever possible, current and province/territory-specific data have been used first to estimate relevant harms from SU that might generate costs. For example, many hospital admissions caused by SU are clearly identified in official diagnostic records (e.g., opioid overdose, SU disorder, alcoholic psychosis). We were able to access individual-level data on the economic costs of different types of hospital admissions and then combine these data to come up with accurate costs for events that are 100% attributable to SU. However, there are also a large number of health conditions and crime events that are only partially attributable to SU. Healthcare and crime records cannot always reliably record the contributions of substance use and so an indirect attributable fraction approach was used to estimate the proportions of health and crime outcomes that could be considered caused by alcohol or other substance use.



For example, an association between specific levels of alcohol consumption and colorectal cancer has been established (World Health Organization, 2014). However, not all cases of colorectal cancer are caused by alcohol use. The attributable fraction approach allows us to estimate the number of cases of colorectal cancer in the population that can be considered to be caused by alcohol consumption. To do so we assess the risk of developing a condition (in this case, colorectal cancer) that is associated with various quantities of alcohol consumption and the proportion of those in a population consuming alcohol at those quantities. Using this information we can determine the proportion of all cases of colorectal cancer that is alcohol-attributable. Multiplying this proportion by the total number of colorectal cancer cases allows us to calculate the number of alcohol-attributable cases of colorectal cancer and the costs associated with treating them. This procedure is then conducted for all the conditions for which alcohol is causally associated (Centers for Disease Control, 2008; World Health Organization, 2014). We then conducted a similar exercise for each and every other substance. Thus the healthcare and lost productivity sections of this report were mostly completed using a condition-based, epidemiological attributable fraction approach. In this approach, the proportion of each SU-related condition that would be eliminated in the absence of SU was calculated. These proportions were used to estimate the healthcare and lost productivity costs incurred within a given year.

Another critical methodological choice was to use the human capital approach to estimate the impacts of premature mortality attributable to SU on lost productivity. However, we did not use this method when estimating the impact of long-term disability on lost productivity because we had a direct estimate of the extent of long-term disability involving all people of working age (assumed to be 15 to 64 years old) provided for most years in a national survey. The methods used were guided by best practices from the field of health economics (Koopmanschap & Rutten, 1996; Rehm et al., 2006; Schroeder, 2012; Single et al., 2003).

For the criminal justice section of this report, new attributable fractions were calculated, using rich data sources from Correctional Services Canada, to estimate the proportion of crime associated with alcohol and the other substance categories. This work represents a major advance in our understanding of the association between SU and crime in Canada.

More details about the attributable fraction approach and how it was applied in estimating the different costs are detailed in the technical report.

### *Estimation of Substance Use Prevalence*

Most of these methodological approaches at some stage required estimates of the prevalence of SU in Canada by province/territory, age, sex, year and type of substance. We drew upon multiple national and province/territory-specific surveys containing questions on SU (see Table 2). For alcohol and tobacco, survey data were complemented with province/territory- and year-specific commercial sales data. For some required data elements, there was either insufficient or missing data for direct estimates. Fortunately, there are predictable trends by sex, age, year, province/territory and type of substance that were discernible within the very large survey datasets available. These consistent trends facilitated accurate modelling to create robust estimates of SU exposures where direct survey estimates were unavailable.

**Table 2.** Data sources used to model prevalence estimates

| Substance  | Data Sources   |
|--|--|
| Alcohol  | CADUMS 2008–2012 (Statistics Canada, 2017e, 2017f, 2017g, 2017h, 2017i); CTADS 2013 and 2015 (Statistics Canada, 2017s, 2017t); CCHS 2005 and 2007–2014 (Statistics Canada, 2017j, 2017k, 2017l, 2017m, 2017n, 2017o, 2017p, 2017q, 2017r); official sales from Statistics Canada 2006–2016 (Statistics Canada, 2017u) |
| Tobacco  | CADUMS 2008–2012 (Statistics Canada, 2017e, 2017f, 2017g, 2017h, 2017i); CTADS 2013 and 2015 (Statistics Canada, 2017s, 2017t); CCHS 2005 and 2007–2014 (Statistics Canada, 2017j, 2017k, 2017l, 2017m, 2017n, 2017o, 2017p, 2017q, 2017r); official sales from Statistics Canada 2006–2016 (Statistics Canada, 2017u) |
| Cannabis, opioids, other CNS depressants, cocaine, other CNS stimulants and other substances | CADUMS 2008–2012 (Statistics Canada, 2017e, 2017f, 2017g, 2017h, 2017i); CTADS 2013 and 2015 (Statistics Canada, 2017s, 2017t); NWTAS 2012 (Northwest Territories Health and Social Services, 2017)  |

In this project, we used the methods of Rehm and colleagues (2006) as a starting point and then made modifications where necessary to estimate new substance categories and in response to the availability of different data sources than those used in the 2006 study. In two important respects, we have modified methodological approaches to more closely match those found in similar international exercises. First, for healthcare and mortality data, we have largely relied on primary diagnoses, the common practice in international SU epidemiology (National Center for Chronic Disease Prevention and Health Promotion, 2014; Sherk et al., 2017a). Second, Rehm and colleagues estimated the costs of long-term disability for all currently disabled people for the year in question (then 2002) and also projected these forward for each individual until the age of 65 years. We believe such a forward estimation overestimates the costs of long-term disability, especially in the context of a time-series analysis where repeated counting of costs across subsequent years occurs. As such, we restricted our estimates to the year of interest, as recommended by Schroeder (2012).

All dollar figures are presented in 2014 Canadian dollars. The national Consumer Price Index was used to adjust costs from earlier study years to 2014 dollars (Statistics Canada, 2018d). In addition, results presented in this report are presented by calendar year. When available data were organized by fiscal year (FY), they were converted into calendar year by allocating 25% of the costs and counts to the following year. For example, when converting FY 2011–2012 to calendar years 2011 and 2012, 25% of FY 2010–2011 was added to 2011, 25% of FY 2011–2012 was added to 2012, and so on.





# Healthcare-related Costs





## Healthcare-related Costs

Cost estimates are provided for SU-attributable inpatient hospitalizations, day surgery treatment episodes, emergency department presentations, specialist treatment for SU disorders, the costs of physician time and prescription drug costs. Fundamental to these estimates is the use of the attributable fraction approach for estimating the proportions of different types of illness or injury that can be attributed to the use of a particular substance. The diagnostic information available for hospitalizations is the most reliable and detailed. This information was used as a basis for estimating SU-attributable health care in other domains as well. Data sources used to develop these estimates are listed in Table 3. For details of methods employed, see the *Canadian Substance Use Costs and Harms Technical Report*.

**Table 3.** Data sources used to calculate costs of health care related to SU

| Substance                            | Data Sources  |
|--------------------------------------|---|
| Substance-use-attributable fractions | <p>Alcohol: Calculated using the International Model of Alcohol Harms and Policies (Sherk et al., 2017b)</p> <p>Tobacco: Relative risks taken for 2014 U.S. <i>Surgeon General's Report</i> (National Center for Chronic Disease Prevention and Health Promotion, 2014)</p> <p>Other substances: Relative risks (various) taken from the literature on a condition-specific basis (see technical report)</p>  |
| Inpatient hospitalizations           | <p>CIHI: Discharge Abstract Database (DAD) 2006–2007 to 2014–2015 (Canadian Institute for Health Information, 2017a, 2017b, 2017c, 2017d, 2017e, 2017f, 2017g, 2017h, 2017i)</p> <p>CIHI: Cost of a Standard Hospital Stay (indicator) (Canadian Institute for Health Information, 2017t)</p>   |
| Day surgeries                        | <p>CIHI: DAD 2006–2007 to 2014–2015 (Canadian Institute for Health Information, 2017a, 2017b, 2017c, 2017d, 2017e, 2017f, 2017g, 2017h, 2017i) and National Ambulatory Care Reporting System (NACRS) 2006–2007 to 2014–2015 (Canadian Institute for Health Information, 2017j, 2017k, 2017l, 2017m, 2017n, 2017o, 2017p, 2017q, 2017q, 2017r, 2017s)</p> <p>CIHI: Cost of a Standard Hospital Stay (indicator) (Canadian Institute for Health Information, 2017t)</p> |



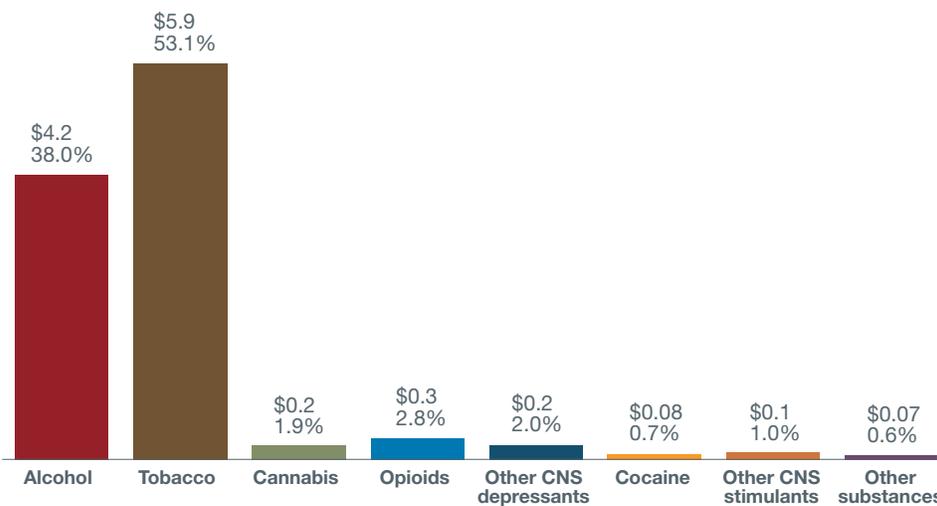
|                                     |   |
|-------------------------------------|---|
| Emergency department visits         | <p>CIHI: NACRS 2006–2007 to 2014–2015 (counts) (Canadian Institute for Health Information, 2017j, 2017k, 2017l, 2017m, 2017n, 2017o, 2017p, 2017q, 2017r, 2017s)</p> <p>CIHI: Cost of a Standard Hospital Stay (indicator) (Canadian Institute for Health Information, 2017t)</p>   |
| Specialized substance use treatment | <p>National Treatment Indicator (NTI) Working Group data 2009–2010 to 2014–2015 (counts) (Beasley, Jesseman, Patton, &amp; National Treatment Indicators Working Group, 2012; McQuaid, Di Gioacchino, &amp; National Treatment Indicators Working Group, 2017; Pirie, Jesseman, Di Gioacchino, &amp; National Treatment Indicators Working Group, 2014; Pirie, Jesseman, &amp; National Treatment Indicators Working Group, 2013; Pirie &amp; National Treatment Indicators Working Group, 2015; Pirie, Wallingford, Di Gioacchino, McQuaid, &amp; National Treatment Indicators Working Group, 2016)</p> <p>CIHI: DAD 2006–2007 to 2014–2015 (Canadian Institute for Health Information, 2017a, 2017b, 2017c, 2017d, 2017e, 2017f, 2017g, 2017h, 2017i) and Cost of a Standard Hospital Stay 2007–2014 (costs) (Canadian Institute for Health Information, 2017t)</p> <p>Literature: <i>Comorbid mental disorders among clients in addiction treatment: the costs of care</i> (costs) (Urbanoski, Rehm, Lange, &amp; Popova, 2014)</p> |
| Family physician time               | <p>CIHI: National Physician Database 2006–2007 to 2014–2015 (Canadian Institute for Health Information, 2017s) and Quick Stats Inpatient Hospitalizations 2007–2014 (Canadian Institute for Health Information, 2018)</p>   |
| Prescription drugs                  | <p>CIHI: National Health Expenditure Trends 2007–2014 (Canadian Institute for Health Information, 2017u)</p>  |



## Results

SU-attributable healthcare costs in 2014 were \$11.1 billion. Costs associated with the use of current legally available substances, alcohol and tobacco were estimated to contribute approximately 91% of all healthcare costs attributable to SU (Figure 5). These costs are broken down by cost type (i.e., inpatient hospitalization costs, day surgery costs, emergency department costs, specialized treatment [residential and non-residential] costs, physician costs and prescription drug costs) by substance (Table 1).

**Figure 5.** Healthcare costs (in billions) and percentage of total healthcare costs attributable to substance use by substance, 2014

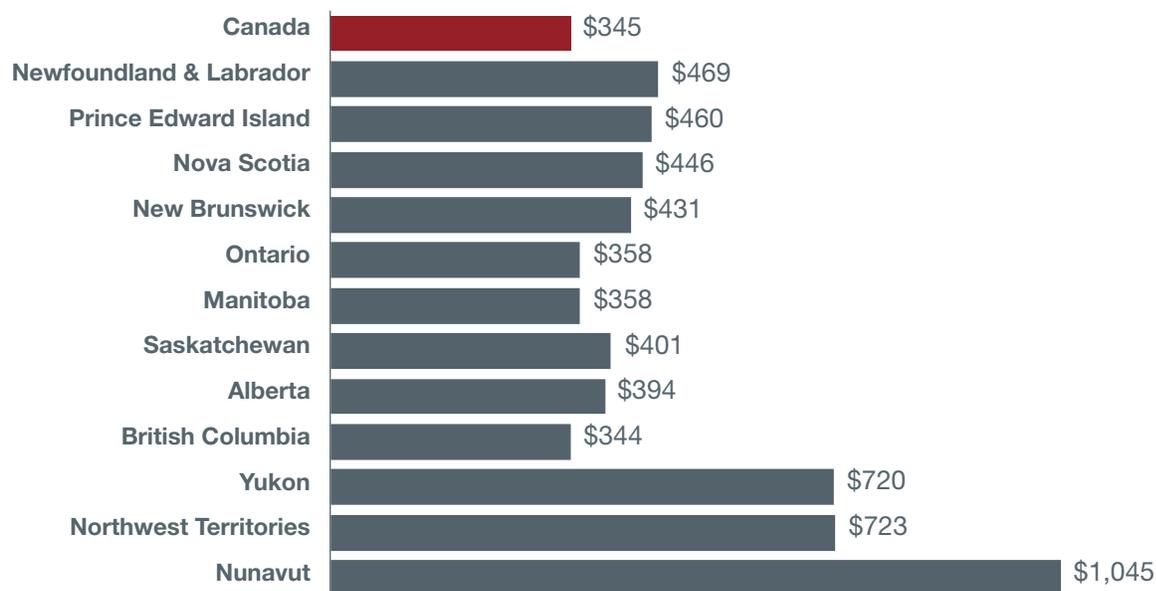


**Note:** A rough calculation based on Ontario per-person costs and data that were available from Quebec suggests that these per-person costs are likely conservative by roughly 8%.

Estimated costs by province or territory are largely driven by population size. Direct comparisons can be made from the data presented in Figure 6, which presents rates of estimated healthcare costs attributable to SU per person. These estimates show that for the whole of Canada (excluding Quebec), healthcare costs attributable to SU cost \$345 per person on average. Per-person costs were highest in the territories and relatively high in Atlantic Canada.



**Figure 6.** Healthcare costs per person attributable to substance use in Canada (except Quebec) by province/territory, 2014



**Note:** Meaningful per-person costs for Quebec could not be calculated.

As shown in Table 4, contributing to these costs were the estimated 255,600 hospitalizations attributable to SU, of which 145,800 were from tobacco and 87,900 from alcohol. By comparison, opioid-attributable hospitalizations were estimated to be the third-highest category with almost 7,000 stays.

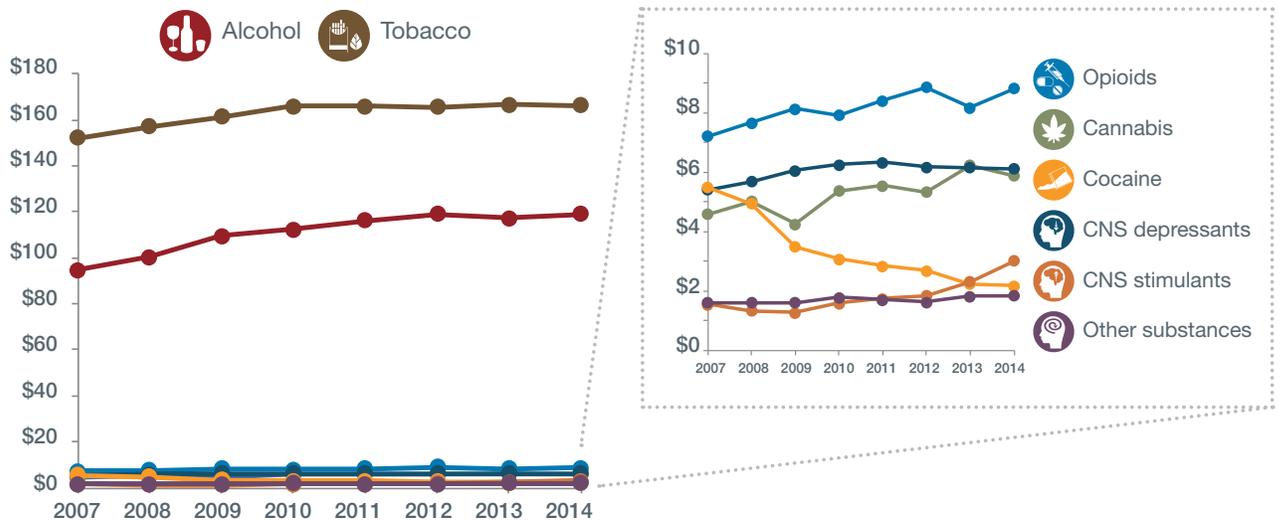
**Table 4.** Hospital stays in Canada (not including Quebec) attributable to substance use in 2014 by type of substance

| Substance             | Number of Hospitalizations | Percentage of Hospitalizations |
|-----------------------|----------------------------|--------------------------------|
| Alcohol               | 87,911                     | 34.4%                          |
| Tobacco               | 145,801                    | 57.0%                          |
| Cannabis              | 3,836                      | 1.5%                           |
| Opioids               | 6,982                      | 2.7%                           |
| Other CNS depressants | 5,534                      | 2.2%                           |
| Cocaine               | 1,572                      | 0.6%                           |
| Other CNS stimulants  | 2,275                      | 0.9%                           |
| Other drugs           | 1,660                      | 0.6%                           |
| <b>Total</b>          | <b>255,571</b>             |                                |



Overall per-person costs associated with SU-related health care increased almost 15% from \$273 in 2007 to \$313 in 2014.<sup>9</sup> Alcohol increased 25.9% from \$95 to \$119 and tobacco increased 9.2% from \$152 to \$166 over this time period (Figure 7). From 2007 to 2014, cannabis increased 27.9% from \$5 per person to \$6 per person. Similar increases were noted for opioids (22.2% increase from \$7 to \$9) and other CNS stimulants, which increased from \$2 to \$3 (see Figure 7). The exception to this pattern was cocaine, which decreased 60.2% from \$5 per person in 2007 to \$2 per person in 2014.

**Figure 7.** Per person healthcare costs (2014 CAD) attributable to substance use in Canada by substance, 2007-2014



**Note:** A rough calculation based on Ontario per-person costs and data that were available from Quebec suggests that these per-person costs are likely conservative by roughly 8%.

### Limitations

Prevalence estimates for substances other than alcohol and tobacco for the three territories had to be modelled with limited territory-specific survey data on the extent of other types of SU. We were only able to include a direct estimate for the prevalence of cannabis use from one survey available for the Northwest Territories in 2012 (Northwest Territories Health and Social Services, 2017). Population data from the territories and highly consistent patterns in the survey data from the provinces were used to estimate the extent of use of prescription and illegal drugs in the territories. It should be noted, however, that more than 90% of the estimated harms in the territories are attributable to the use of alcohol and tobacco and that some Canadian Community Health Survey data were available to estimate prevalence of use of these two legally available substances.

The absence of direct estimates of SU prevalence in the territories does not affect estimates of conditions that are 100% attributable to SU, which account for a large majority of cases (e.g., from SU disorders [the largest single category] and overdoses). We also conducted a validation exercise that demonstrated that the ratio of 100%-attributable conditions to partially attributable conditions in the territories was quite similar to that of the provinces. This finding suggests that the modelled estimates for the territories were reasonable.

<sup>9</sup>Only some healthcare-related data were available for Quebec. These national per-person trend estimates include Quebec and therefore differ from the \$345 indicated above.



# Lost Productivity Costs



## Lost Productivity Costs

Estimates are provided for the indirect costs associated with SU-related lost productivity (in terms of foregone earnings) due to premature mortality, long-term disability, absenteeism and impaired performance (“presenteeism”). The human capital approach was the primary method used to estimate lost productivity costs due to premature mortality, which assumes the deceased individual cannot be replaced in the workforce and their lost income up to the age of retirement is not recoverable. Lost productivity costs due to long-term disability, absenteeism and presenteeism were calculated using data from the Canadian Community Health Survey. The data sources used to develop these estimates are listed in Table 5. For details on the methods employed to produce our estimates, see the *Canadian Substance Use Costs and Harms Technical Report*.

**Table 5.** Data sources used to calculate costs of health care related to SU

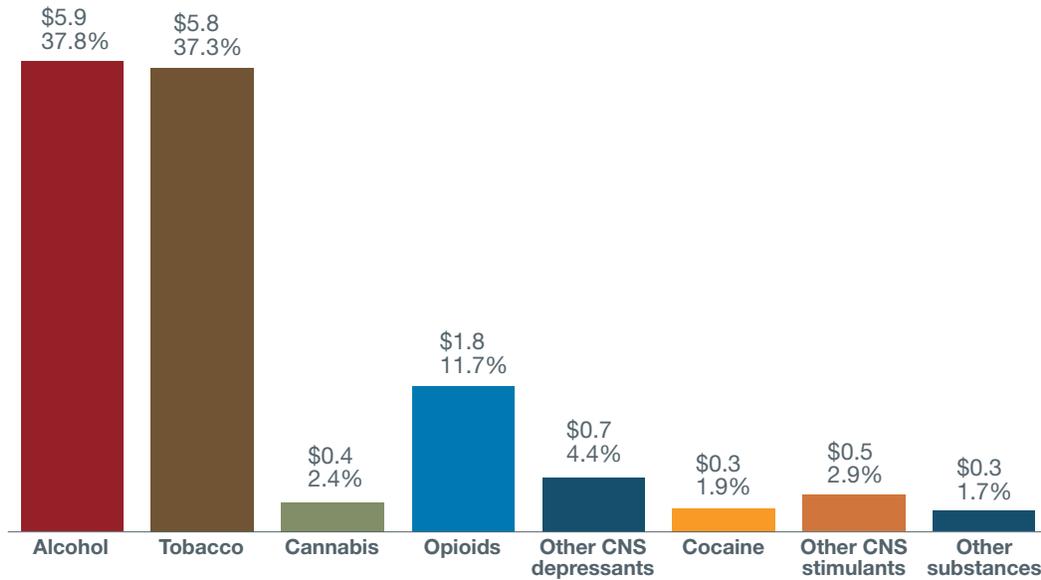
| Substance  | Data Sources   |
|--|--|
| Premature mortality                                  | Vital Statistics – Death Database (Statistics Canada, 2017v); General Social Survey (Statistics Canada, 2017d) (counts); Labour Force Survey (Statistics Canada, 2017c); Job Vacancy and Wages Survey (Statistics Canada, 2017b) (costs) |
| Long-term disability                                 | Canadian Community Health Survey (Statistics Canada, 2017j, 2017k, 2017l, 2017m, 2017n, 2017o, 2017p, 2017q, 2017r) (counts and costs)   |
| Short-term disability (absenteeism and presenteeism) | Canadian Community Health Survey (Statistics Canada, 2017j, 2017k, 2017l, 2017m, 2017n, 2017o, 2017p, 2017q, 2017r) (counts and costs)   |

### Results

SU-attributable lost productivity costs in 2014 were \$15.7 billion. Costs associated with the use of current legally available substances (alcohol and tobacco) were estimated to contribute slightly more than 75% of all lost productivity costs associated with SU (see Figure 8).

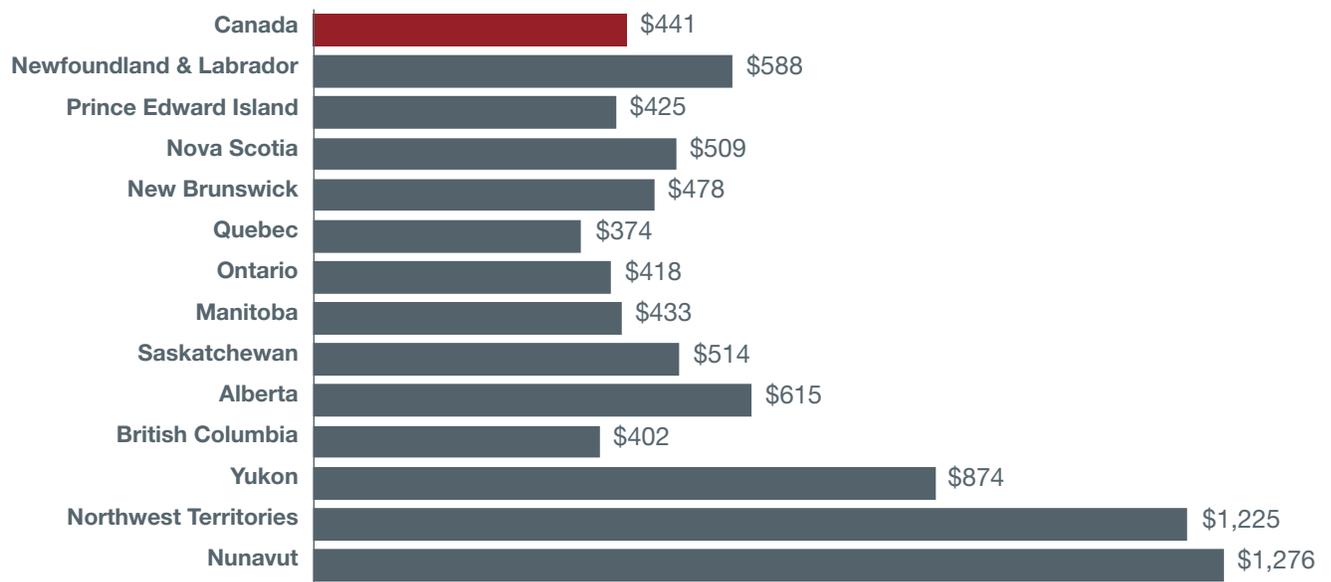


**Figure 8.** Costs (in billions) of lost productivity attributable to substance use in Canada by substance, 2014



The estimated per-person lost productivity costs attributable to SU for the provinces, territories and Canada are presented in Figure 9. For the whole of Canada, lost productivity attributable to SU costs an average of \$441 per person. Per-person costs were highest in the territories.

**Figure 9.** Per person lost productivity costs attributable to substance use in Canada by province/territory, 2014





Overall per-person lost productivity costs increased by approximately 8.4% from \$406 in 2007 to \$441 in 2014. The per-person costs of lost productivity due to alcohol and tobacco both increased by similar amounts over the course of the study, with the costs related to alcohol increasing by more than 8% (from \$153 in 2007 to \$166 in 2014) and those related to tobacco increasing by about 6% (from \$155 in 2007 to \$164 in 2014) (Figure 10). The largest increase occurred among opioids, with the per-person cost increasing by more than 20% over the course of the study (from \$43 per person in 2007 to \$52 per person in 2014) (Figure 10). This increase is likely due to the growing number of opioid-related premature deaths (Table 6). Increased lost productivity costs were also observed among other CNS depressants, with per-person costs increasing by 16% from \$17 in 2007 to \$19 in 2014. The only substance associated with a decrease in lost productivity costs was cocaine, with per-person costs falling by more than 22% over the course of the study (from \$11 per person in 2007 to \$8 per person in 2014).

Underlying these costs are the estimated numbers of deaths and the potential years of productive life lost (PYPLL), as shown in Table 6 and Table 7, respectively. Tobacco was the leading cause of the 67,515 SU-attributable deaths with 47,562 deaths in 2014, followed by alcohol with 14,827 deaths and opioids with 2,396 deaths. One measure of the toll of SU-attributable mortality is the total number of PYPLLs, which amounted to 751,369 in 2014 (Table 6). Tobacco use was the leading cause of PYPLLs with 326,870, followed by alcohol with 244,144.

**Table 6.** Number of deaths, average age at death and potential years of life lost due to substance use-attributable premature mortality, 2014

| Substance             | Deaths        | Average Age at Death | Potential Years of Life Lost due to Premature Mortality |
|-----------------------|---------------|----------------------|---|
| Alcohol               | 14,827        | 65.3                 | 244,144   |
| Tobacco               | 47,562        | 75.4                 | 326,870   |
| Cannabis              | 851           | 61.8                 | 18,301  |
| Opioids               | 2,396         | 45.5                 | 87,782  |
| Other CNS Depressants | 796           | 46.4                 | 28,792  |
| Cocaine               | 297           | 38.0                 | 13,015  |
| Other CNS stimulants  | 487           | 38.8                 | 21,038  |
| Other drugs           | 299           | 44.3                 | 11,427  |
| <b>Total</b>          | <b>67,515</b> | <b>71.0</b>          | <b>751,369</b>  |

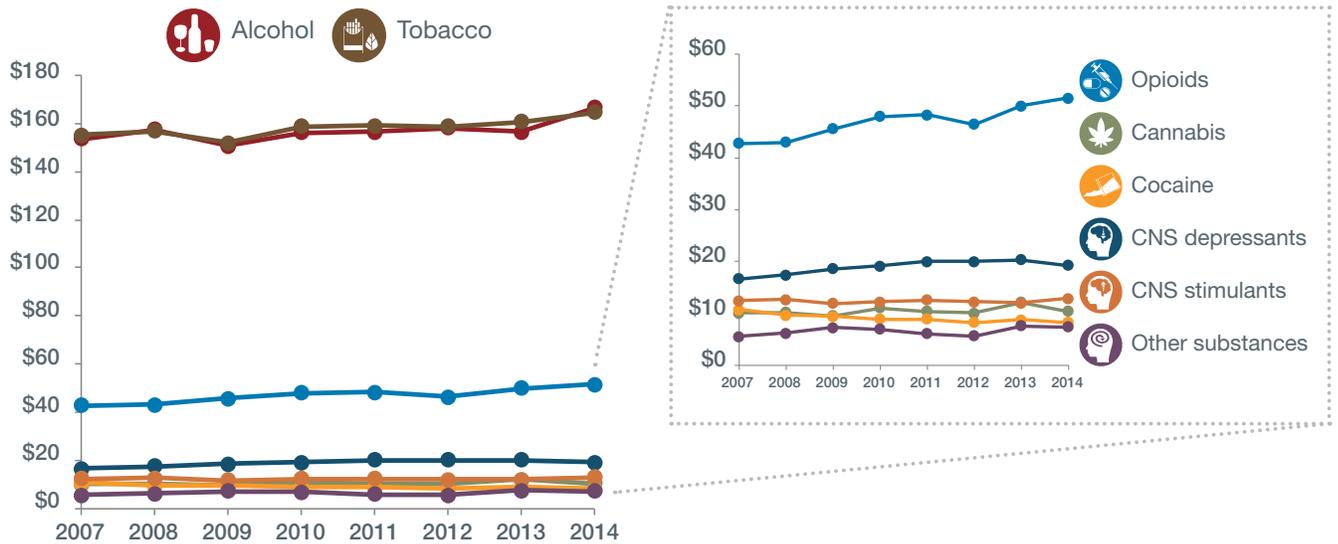
PYPLLs are calculated up to 65 years of age. Because of the young age at which many alcohol attributable deaths and injuries occur, alcohol was leading contributor to the 351,516 SU-attributable PYPLLs with 138,980 in 2014. Due to the young age of many opioid-related deaths (mean=45.5), opioids contributed as many as 52,061 PYPLLs.



**Table 7.** Number of individuals (age 0–64 years) removed from the workforce and potential years of productive life lost due to substance use-attributable premature mortality and long-term disability, 2014

| Substance             | Individuals Removed from the Workforce | Potential Years of Productive Life Lost |
|-----------------------|--|---|
| Alcohol               | 35,777                                 | 138,980                                 |
| Tobacco               | 39,727                                 | 104,869                                 |
| Cannabis              | 2,109                                  | 8,436                                   |
| Opioids               | 4,636                                  | 52,061                                  |
| Other CNS depressants | 2,569                                  | 17,443                                  |
| Cocaine               | 883                                    | 8,827                                   |
| Other CNS stimulants  | 1,332                                  | 13,943                                  |
| Other drugs           | 875                                    | 6,957                                   |
| <b>Total</b>          | <b>87,908</b>                          | <b>351,516</b>                          |

**Figure 10.** Per-person lost productivity costs (2014 CAD) attributable to substance use in Canada by substance, 2007–2014





### *Limitations*

For our estimates of SU-related long-term disability, we examined the prevalence of individuals who were absent from the workforce due to long-term disability and estimates to the year of interest, as recommended by Schroeder (2012). This is a different, more conservative method than the one used by Rehm and colleagues (2006) as well as in other cost studies. Our results are therefore not directly comparable to the results from these earlier studies. For more details about the limitations on the methods used to calculate lost productivity costs associated with premature mortality, long-term disability, absenteeism or presenteeism, refer to Chapter 13 of the *Canadian Substance Use Costs and Harms: Technical Report*.

# Criminal Justice Costs





## Criminal Justice Costs

Criminal justice costs include those associated with policing, courts and corrections. Included in our calculations are expenditures for criminal offences that are 100% attributable and partially attributable to SU. The 100% attributable offences include impaired driving as well as drug-related offences that are in violation of the *Controlled Drugs and Substances Act* (CDSA), including the possession, trafficking and production of controlled substances. In addition to fully attributable criminal offences, we also included criminal offences partially attributable to SU (e.g., violent offences such as homicide or assault, non-violent offences such as theft or arson). As described in the *Canadian Substance Use Costs and Harms: Technical Report*, crime-attributable fractions for Canadian men and women were estimated based on a comprehensive intake survey given to more than 29,000 offenders as they entered federal prisons about the role SU played in their offences (see Table 8). Estimates of prevalence of use for each substance were applied to further modify these fractions by age, year and region.

The resulting attributable fractions by substance were applied to counts of partially attributable, *Criminal Code* incidents (for policing costs), charges (for court costs) and admissions to correctional facilities (for correctional costs). The result was added to the number of fully attributable incidents, charges or admissions, and then divided by the total to assess the proportion of SU-attributable counts. The resulting proportions were then applied to the total costs associated with policing, court and correction costs by year and province/territory.

**Table 8.** Data sources used to estimate crime costs attributable to SU

| Costs/Harm                                    | Data Sources  |
|---|---|
| Crime-related attributable fractions          | Correctional Service of Canada: Computerized Assessment of Substance Abuse (CASA) (Kunic & Grant, 2006); Women's CASA (Correctional Service of Canada, 2017)  |
| Police (crime incidents)                      | Uniform Crime Reporting Survey 2009–2014 (Statistics Canada, 2017a)   |
| Courts (charges)                              | Integrated Criminal Court Survey 2008/09–2014/15 (Statistics Canada, 2018b)   |
| Corrections (admissions to sentenced custody) | Adult Correctional Services 2008/09–2014/15 (Statistics Canada, 2018a); Youth Custody and Community Service Survey 2008/09–2014/15 (Statistics Canada, 2018c)   |
| Criminal justice costs                        | Office of the Parliamentary Bureau Officer: Expenditure Analysis of Criminal Justice in Canada, 2013 (Story & Yalkin, 2013); Treasury Board of Canada Secretariat: Tobacco Control Strategy 2006/07–2014/15 (Treasury Board of Canada Secretariat, 2015). |



## Results

According to our newly generated attributable fractions, 43% of all partially attributable crimes (i.e., excluding impaired driving and crimes defined under the CDSA) are attributable to SU. Alcohol was associated more with violent crime (20%) than non-violent crime (8%), while other substances were associated with violent and non-violent crime almost equally (26% and 25%, respectively) (see Table 9).

**Table 9.** Attributable fractions for substance use related crime

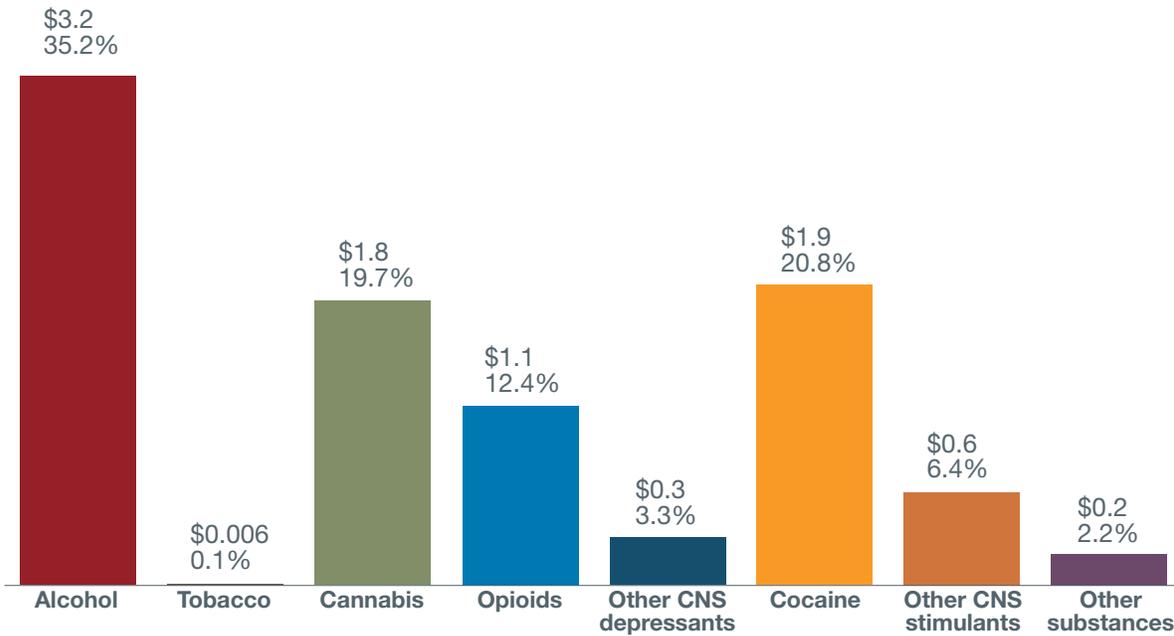
| Substance             | Attributable fractions |   |
|-----------------------|------------------------|---|
|                       | Violent offences       | Non-violent offences (excluding substance defined offences) |
| Alcohol               | 0.199                  | 0.080   |
| Cannabis              | 0.055                  | 0.027   |
| Opioids               | 0.047                  | 0.063   |
| Other CNS depressants | 0.012                  | 0.010   |
| Cocaine               | 0.107                  | 0.105   |
| Other CNS stimulants  | 0.032                  | 0.033   |
| Other substances      | 0.010                  | 0.010   |
| All substances        | 0.462                  | 0.328   |

In 2014, almost \$9 billion was spent on SU-attributable criminal justice costs. Alcohol accounted for more than one-third of these costs (see Figure 11). Compared to the other cost types examined in this report, criminal justice costs associated with tobacco was the lowest of all substances examined. There are few tobacco-related offences or correctional costs associated with tobacco and only limited costs related to tobacco control and enforcement.

Following alcohol, cocaine was the substance responsible for the highest costs to the criminal justice system. Despite prevalence rates of less than 2% in the Canadian general population, cocaine was associated with 10.7% of all violent crime and 10.5% of all non-violent offences (not including 100% SU-attributable crimes). Almost 90% of the criminal justice costs associated with cocaine were due to policing, court and corrections costs associated with violent and non-violence offences, with the remaining 10% associated with violations of the CDSA. In contrast, almost 60% of cannabis-related criminal justice costs were associated with violations of the CDSA. Costs incurred from policing crimes related to SU were the highest, followed by correctional costs and court costs.

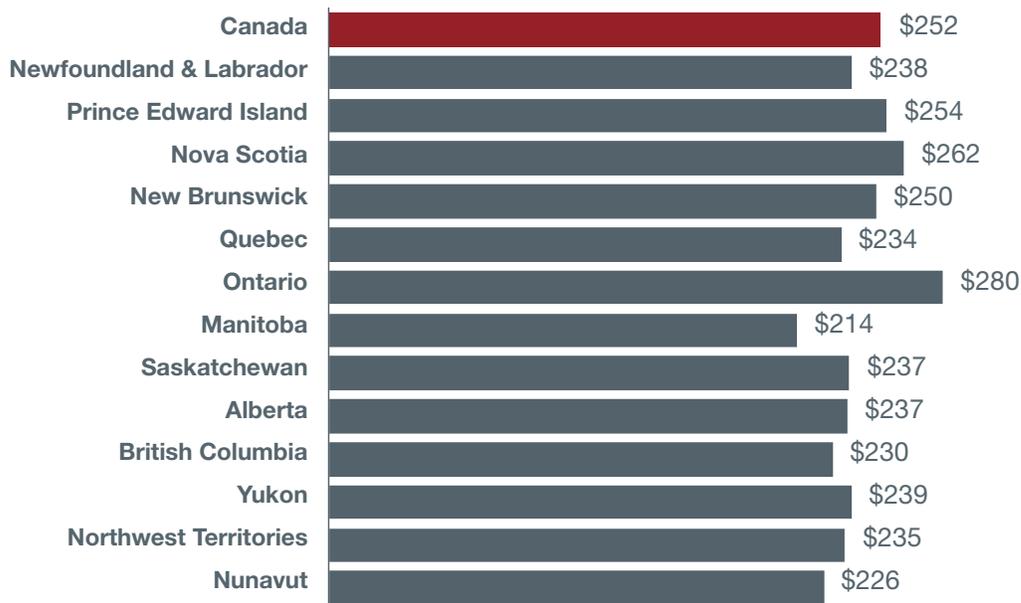


**Figure 11.** Criminal justice costs (in billions) and percentage of total criminal justice costs attributable to substance use by substance, 2014



The per-person criminal justice costs of SU in 2014 were \$252 (see Figure 12). These costs were highest in Ontario and lowest in Manitoba.

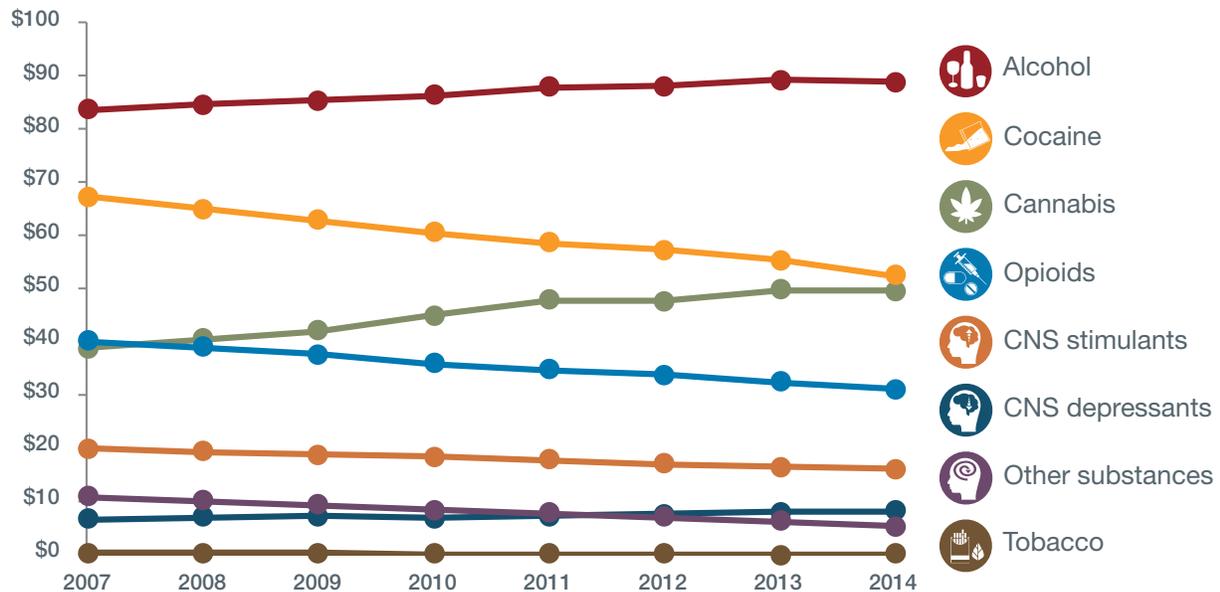
**Figure 12.** Per person criminal justice costs attributable to substance use in Canada by province/territory, 2014





Although overall per-person criminal justice costs remained relatively stable between 2007 and 2014, there were differences by substance. Per-person criminal justice costs associated with alcohol increased 6% from \$84 per person in 2007 to \$89 per person in 2014 (see Figure 13), and cannabis-related costs increased 27% from \$39 per person in 2007 to \$50 per person in 2014 (see Figure 13). During that same time frame, cocaine- and opioid-related per-person costs decreased by 22% and 23%, respectively.

**Figure 13.** Per person criminal justice costs (2014 CAD) attributable to substance use in Canada by substance, 2007–2014



### Limitations

Despite having relatively comprehensive data, in some cases imputations were necessary to estimate for missing data. For example, linear projections were conducted to estimate policing, courts and corrections costs for 2013 and 2014. In addition, costing data were reported only for certain province/territories; therefore, imputations were necessary to distribute costs across the provinces/territories for which there were no data.

Due to changes in the recording of data by certain agencies, we were unable to obtain comparable counts for crime incidents and charges prior to 2009. Given that these counts are critical in estimating the criminal justice costs attributable to SU, we were unable to provide cost estimates for 2008 and 2009. Instead, we used linear trend projection to estimate criminal justice costs attributable to SU for these two years.





# Other Direct Costs





## Other Direct Costs

Other direct costs include estimates for expenditures related to SU across several miscellaneous categories, including research and prevention (which are considered policy costs [Single et al., 2003]), fire damage, motor vehicle damage and workplace costs not already covered in our review of lost productivity costs (i.e., employee assistance programs, drug testing programs and administrative costs associated with workers' compensation).

The methods used to estimate SU-attributable costs varied significantly across the different categories. Some expenditures, such as workplace drug testing and federal spending dedicated to SU research and prevention, are considered 100% attributable to SU. For other categories, such as property damage from fires or motor vehicle damage attributable to the use of a particular substance, the attributable fraction approach was used to estimate the proportion of cost attributable to SU. Methods employed for each category are described in detail in the *Canadian Substance Use Costs and Harms: Technical Report*. The data sources used to develop the cost estimates are listed in Table 10.

**Table 9.** Data sources used to estimate other direct costs attributable to SU

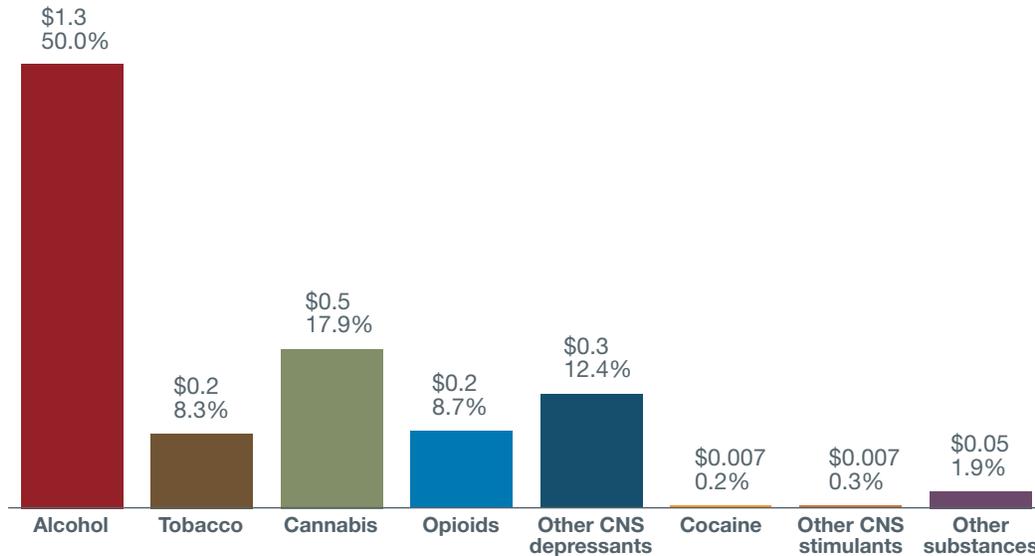
| Costs/Harm                                 | Data Sources   |
|--|--|
| Research and prevention                    | Health Canada; Canadian Institute for Health Research; Heart and Stroke Foundation; Canadian Cancer Society; Canadian Partnership Against Cancer; Canadian Council for Tobacco Control; Traffic Injury Research Foundation; Treasury Board of Canada Secretariat: Tobacco Control Strategy 2006/07–2014/15 |
| Fire damage                                | Provincial/territorial fire marshal and fire commissioners reports 2007–2014; personal communications with provincial/territorial fire marshals and fire commissioners   |
| Motor vehicle damage                       | National Collision Database (Transport Canada, 2017) (counts); General Insurance Statistical Agency (2017) (costs)   |
| Workplace drug-testing programs            | Barbara Butler & Associates (2012) (counts and costs)  |
| Employee-assistance programs               | Labour Force Survey 2007–2014 (Statistics Canada, 2017c); Macdonald & Wells (1995) (counts); personal communications with Morneau Shepell (costs)  |
| Workers' compensation administrative costs | Provincial/territorial workers' compensation boards annual reports 2007–2014   |

## Results

In 2014, close to \$2.7 billion was spent on other direct costs attributable to SU. Half of these costs were attributable to alcohol (see Figure 14). Cannabis accounted for the second-highest proportion of other direct costs at almost 18%.



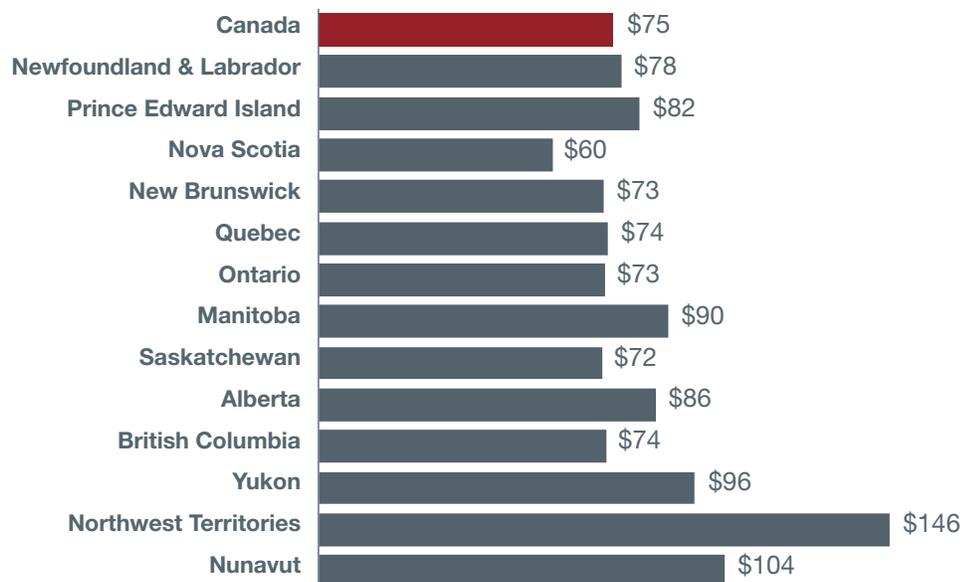
**Figure 14.** Other direct costs (in billions) and percentage of total other direct costs attributable to substance use by substance, 2014



The largest proportion of other direct costs expenditures was associated with motor vehicle damage, which accounted for almost \$1.7 billion. This was followed by fire damage to property, which totalled \$590 million.

The rates of estimated other direct costs attributable to SU per person are shown in Figure 18. In 2014, for Canada as a whole, approximately \$75 per person was spent on other direct costs attributable to SU. The range in costs was fairly broad across the country with a low of \$60 spent per person in Nova Scotia and a high of \$146 spent per person in the Northwest Territories.

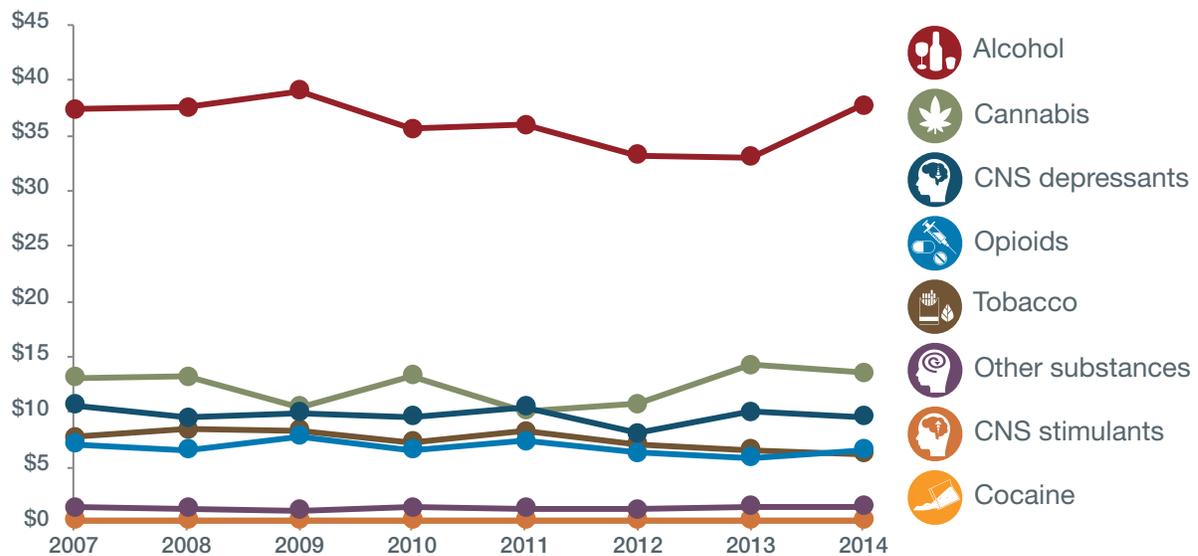
**Figure 15.** Per-person other direct costs attributable to substance use in Canada by province/territory, 2014





The other direct costs associated with the substances assessed in this report were relatively stable from 2007 to 2011. These yearly cost trends largely mirror those of motor vehicle damage, which is consistent with the major contribution of this expenditure category to the total other direct costs. Similar trends are observed in the rates of estimated other direct costs attributable to SU per person in Canada for years 2007 to 2014 (see Figure 16).

**Figure 16.** Per-person other direct costs (2014 CAD) attributable to substance use in Canada by substance, 2007–2014



## Limitations

Due to the heterogeneous nature of the datasets that were used to estimate other direct costs attributable to SU, the unique limitations associated with each dataset are described at the end of each of the cost categories in the *Canadian Substance Use Costs and Harms: Technical Report*. In general, the SU-attributable other direct costs were largely accounted for by expenditures on motor vehicle damage (63%) and fire damage (22%) and so were largely influenced by the limitations associated with these datasets.

# Strengths and Limitations



|     |                |
|-----|----------------|
| Jan |                |
| Feb | \$             |
| Mar | \$87.          |
| Apr | \$2,874.9      |
| May | \$8,923,897.00 |
| Jun | \$8,374.98     |
| Jul | \$849,571      |
| Aug |                |



## Strengths and Limitations

To estimate comprehensively the economic costs of SU across the domains of healthcare, lost productivity, crime and miscellaneous direct costs for eight categories of substance, 13 jurisdictions and eight years was, needless to say, a substantial undertaking. We have endeavoured to use best practice methodologies and the most up-to-date available sources, and to draw on multiple official data sources. Notable strengths of the exercise include:

- (i) Use of the latest WHO burden of disease methodologies (Degenhardt et al., 2016) and estimates for the contributions of SU to disease and injury as, for example, summarized in the new international resource InterMAHP (Sherk et al., 2017b);
- (ii) Use of a comprehensive survey administered to offenders on admission to federal penitentiaries that specifically enquires about the role of psychoactive substances in the commission of their crimes;
- (iii) Application of recommended modern methods for estimating impacts on lost productivity from both long-term disability and premature mortality (Schroeder, 2012); and
- (iv) Comprehensive modelled estimates of SU prevalence by age, sex, jurisdiction, year and type of substance, incorporating data from approximately 150,000 Canadians who have completed various national, provincial and territorial surveys.

Nonetheless, when interpreting the estimates and placing them in context it is important to be aware of some limitations and areas of uncertainty. Most of these limitations have been described in the relevant sections of the report. However, there are some that apply more broadly and are therefore worth noting.

First, the burden of disease methodology relies on the assumption that high-quality studies from across the world on the association between exposure to substances in a population and disease and injury outcomes have universal applicability. While local input data are required on the prevalence of broad categories of disease and injury as well as on rates of SU, it is necessary to import assumptions about the risk relationship between SU and the incidence of some disease and injury outcomes. We have relied on the latest systematic reviews and meta-analyses of the international literature upon which to make best estimates of these risk relationships. The evidence base of published studies, however, is stronger in some areas than in others. In general, the published literature is stronger in relation to tobacco and alcohol use, and weaker for most illicit substances.

Second, we rely extensively on self-reported data throughout the study. It is well known that self-reported levels of SU, particularly for illicit substances, are underestimated to some degree (Zhao, Stockwell, & MacDonald, 2009). We are likely therefore to have underestimated the prevalence of SU and associated costs. Furthermore, direct estimates from surveys of the prevalence of use different types of substances were not available for the years 2007 or 2014, and so estimates generated from a large dataset of available survey data and consistent trends available over time and place and by age and sex were incorporated. Direct survey data on self-reported SU for the territories were only available for alcohol, tobacco and cannabis for some years and extrapolation made for other years based on patterns observed nationally for different age and sex groups. Territory-specific estimates of rates of other SU were modelled based on the large set of provincial data. Fortunately, the majority (about 70%) of healthcare conditions related to illicit SU can be



estimated directly from diagnostic data and do not need to be imputed from self-report survey data using the attributable fraction methodology, so this area of uncertainty is relatively small.

Finally, like Rehm and colleagues (2006), we relied heavily on estimates of the contribution of SU to hospitalizations given the strong and reliable data available from the Canadian Institute for Health Information. The proportional contributions by substance and year to these healthcare events were directly applied to other areas of health care including prescription drugs and physician costs. We cannot be certain of course of the extent to which these proportional contributions by different types of substance apply to these diverse areas of health care. We also inherited limitations in each of the major databases we drew upon for our analyses. For example, reports on the extent to which different substances were detected in the blood of drivers produced for several years included estimates of these based on the number of single-vehicle night-time crashes, which are known to be highly associated with alcohol use. However, the extent of this relationship in each jurisdiction and year will vary and these estimates contain a degree of uncertainty.

Despite these limitations and assumptions, we used the most up-to-date, reliable and comprehensive data and methods available in developing our estimates. In the future there will no doubt be better data and more research available that will allow us to improve on our estimates (as we improved on Rehm et al., 2006). Until such data and research become available, we feel confident that we have developed the best estimates possible.





# Conclusions and Implications



## Conclusions and Implications

The cost estimates given in this report provide a valuable baseline for Canada at a time when major changes and challenges are underway in relation to patterns of SU and their related harms. As of the time of writing, cannabis will soon be legalized and it will be important to see whether rates of use and harms increase. Rates of cannabis use are currently far lower than those for alcohol and tobacco and, in 2014, were slightly lower than those for opioid drugs. The year of focus for this report, 2014, is at the very beginning of the current alarming rise in opioid overdose events in Canada and it can be expected that the associated economic costs of opioid use will increase, probably quite substantially.

It should also be kept in mind that a number of Canadian jurisdictions, such as British Columbia and Ontario, have substantially loosened restrictions on the sale of alcohol since 2014, suggesting there might be increasing harms attributable to alcohol in future estimates. However, there could also be countervailing trends depending on the extent to which increased cannabis use substitutes for the use of alcohol (Baggio, Chong, & Kwon, 2017).

Regarding tobacco use, there is increasing evidence that electronic cigarettes have been taking market share and there are grounds to suggest these will be substantially less harmful. It will be important to monitor the extent to which individuals who currently smoke tobacco are switching to these products and also how new cohorts of young people choose between smoking tobacco and vaping electronic cigarettes. Recent Canadian data indicates decreased use of tobacco alongside increased use of electronic cigarettes by youth (Hammond, Reid, Cole, & Leatherdale, 2017).

It will be necessary to monitor trends in all these major categories of SU in Canada and their related harms and costs over the years ahead. The estimates presented in this report will be updated to provide a dynamic, continuously updated resource for decision makers, policy advisors and researchers.



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