Estimating the Presence of Alcohol and Drug Impairment in Traffic Crashes and their Costs to Canadians: 1999 to 2003

Submitted to **MADD Canada** by:

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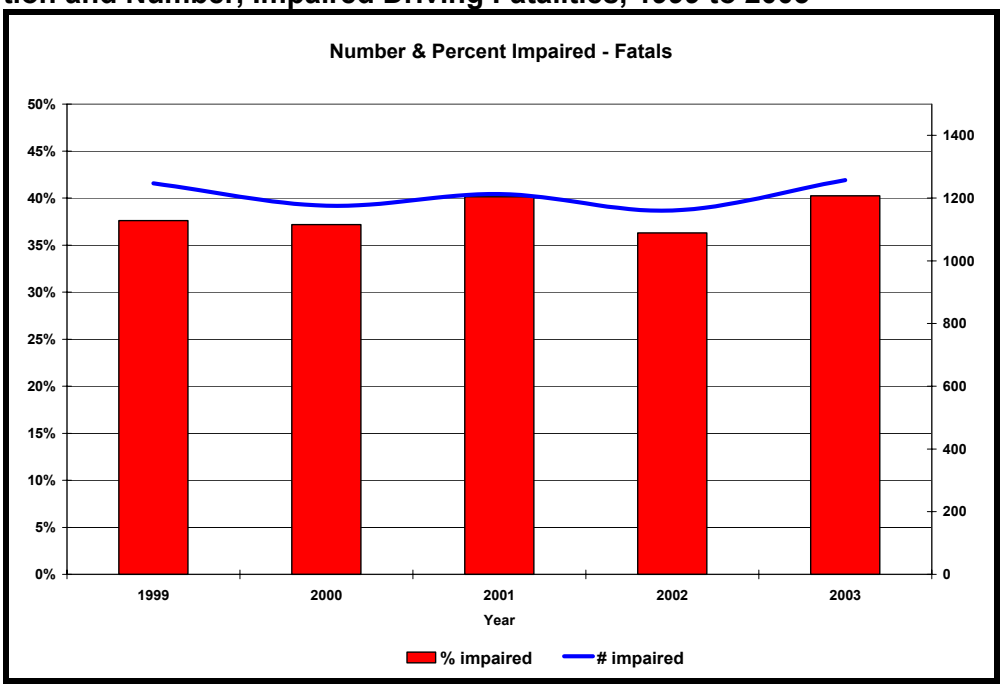
Executive Summary

Over the five-year period between 1999 and 2003, it is estimated that impaired driving killed **6,053** persons, injured **357,155**, and caused damage to **1,180,428** vehicles, translating into **5,045** fatal crashes, **244,136** injury-only crashes and **776,597** property-damage only (PDO) crashes, totaling **812,725** crashes in all.. In turn, this cost Canadians between **$9.2 billion** (Real Dollar Estimate model) and **$53.4 billion** (Willingness to Pay model) dollars, depending on the costing model and assumptions used. To put this another way, that represents a cost of between about **$293.00** and **$1,704.00** per Canadian.

In an average year in Canada, impaired driving killed **1,211** persons, injured **74,181**, and caused damage to **245,174** vehicles, translating into **1,009** fatal crashes, **48,827** injury-only crashes and **155,319** property-damage only (PDO) crashes, totaling an average of **205,156** crashes in all.. In turn, on average, this cost Canadians between **$1.8 billion** (Real Dollar Estimate model) and **$10.7 billion** (Willingness to Pay model) dollars, depending on the costing model and assumptions used. To put this an other way, that represents a cost of between about **$59.00** and **$341.00** per Canadian.

Proportion and Number, Impaired Driving Fatalities, 1999 to 2003



Turning to 2003, the most recent year of data, it is estimated that, for Canada, impaired driving, including impairment by drugs other than alcohol, resulted in **3,124 fatalities**, **368,632 injuries** and, including property-damage-only, a total of **213,053 crashes,** at a cost of **between $1.9 and $11.0 billion dollars**, depending upon the costing model used.

While these figures can only be considered as order-of-magnitude approximations, the issue of more precisely determining the magnitude of impaired driving crashes and attendant costs is important and worthy of consideration by researchers and policy makers alike.

Estimating the Presence of Alcohol and Drug Impairment in Traffic Crashes and their Costs to Canadians: 1999 to 2003[1]

The Model for Estimation:

Knowledge of the extent of harm caused by traffic crashes, and by the sub-set of crashes caused by impairment, is important in the development of public policy and the allocation of countermeasure resources.

The more serious a crash, the more likely it will be reported to or otherwise become known to various authorities such as the police, motor vehicle branches, insurance companies, and the coroner, and the more likely it will be investigated by one or more of those bodies. Consequently, Canadian data on motor vehicle fatalities, and whether or not the fatally injured person(s) had measurable blood alcohol content (BAC), is largely complete, valid and reliable. That is, we have very good information the number of persons killed in crashes, and whether or not they were possibly impaired by alcohol. On the other hand, the data on whether or not a fatally injured person might have been impaired by drugs is incomplete, primarily due to a lack of testing and testing sensitivity.

As crashes become less serious, there is less likelihood that they will be reported, recorded, or investigated. In order to assess the magnitude of the traffic crash and impairment-caused traffic crash problem, there is a need to find a way to estimate the number of less severe crashes, and whether or not they might have been caused by impairment by alcohol and/ or drugs.

Historically, crashes reported to the police have been used as a measure of crash frequencies and types, with the police forwarding crash reports to provincial Motor Vehicle Branches for compilation and statistical analyses. However, a comparison of the frequencies of these reports with data from insurance company crash counts shows an underreporting of less serious crashes in the police-generated data (Mercer & Marshall, 2002). This could be because of a lack of policing resources, a reluctance on the part of drivers to report crashes to the police (but a desire for financial compensation from insurance companies) or both. Certainly, some proportion of crashes will never be reported to anyone and will just be settled privately, but insurance-based counts seem to gather many more crash instances than do police data counts.

An examination of insurance-based and other data sources suggests that there may be a roughly stable relationships among the number of motor-vehicle related fatalities to the number of injuries to the number of property damage only (PDO) events, such that there appears to be about 118 injuries, and 650 PDO events for each fatality (Mercer & Marshall, 2002). Using these

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[1] In 2002 MADD Canada commissioned Applied Research and Evaluation Services (ARES – www.ares.ubc.ca) at the University of British Columbia to consider the extent and cost of impaired driving crashes in Canada for the year 1999 (Mercer & Marshall, 2002). That full report is at http://www.madd.ca/english/research/magnitude_report2k2.doc and explains in detail how the model of that estimate was constructed. None of the assumptions around the model have changed for this brief report.

multipliers, one can move from the very good information on the frequencies of fatalities, to an estimation of the frequencies of less serious crashes.

Similarly, an examination of BAC levels associated with different levels of crash-related injury severity (from no injury to fatality) can produce a rough estimation of the proportion likely impaired by alcohol in less severe crashes for every one percent impaired by alcohol in fatal crashes. An examination of these relationships showed that as crash severity lessened, the likelihood of impairment being a cause lessened. From the examination of the BAC data, it has been suggested that for every one percent of fatal injuries associated with an impaired crash, about half of one percent of injury-only crashes were likely to be associated with alcohol-impairment, and about three-tenths of one percent of PDO events were likely to be associated with alcohol-impairment (Mercer & Marshall, 2002). To put this another way, if the percent of alcohol-impaired crashes went up by 10%, the percent of alcohol-impaired injury crashes would go up by 5% and the percent of PDO crashes would go up by 3%. Again, using these multipliers, one can move from very good information on the frequencies of impairment-related fatalities to an estimation of the frequency of impairment in less serious crashes.

Finally, from an examination of studies of the impairing role of drugs as well as alcohol in crashes it has been suggested that where there is a positive BAC, about 75% of the instances involve alcohol alone, about 25% of the instances where alcohol was involved there were likely also drugs involved, and that there was an additional 10% of persons likely impaired by drugs over and above those impaired by alcohol alone or alcohol and drugs (Mercer & Marshall, 2002).

Calculation of Frequencies:

In order to estimate the extent of fatal, injury and PDO events, it was assumed that there were 118 injuries and 650 PDO events for every fatal event. Those multipliers were applied to the known number of motor vehicle-related fatal events in Canada as reported by: the Traffic Injury Research Foundation (Mayhew et al., 2001) for 1999; the Canadian Council of Motor Transport Administrators (CCMTA) Standing Committee on Road Safety Research Policies paper The Alcohol-Crash Problem in Canada: 2000 for 2000; the CCMTA paper The Alcohol-Crash Problem in Canada: 2001 for 2001; the CCMTA paper The Alcohol-Crash Problem in Canada: 2002 for 2002, and the CCMTA paper The Alcohol-Crash Problem in Canada: 2003 for 2003.

Table 1: Estimated Fatalities, Injuries & PDO Vehicles, Canada, 1999 to 2003

Year	Fatalities	Injuries @118	PDO veh. @ 650
1999	**3,315**	391,170	2,154,750
2000	**3,162**	373,116	2,055,300
2001	**3,021**	356,478	1,963,650
2002	**3,197**	377,246	2,078,050
2003	**3,124**	368,632	2,030,600

Again, working from the above sources, the percent of persons killed in motor vehicle-related crashes, on-road or off-road, where alcohol was involved was used as a starting point to estimate the numbers injured and PDO events, using the notion that for every 1% fatal there would be 0.5% injured and 0.3% in PDO events. That resulted in:

Table 2: Estimated % Alcohol-Involved - Fatalities, Injuries & PDO Vehicles, Canada, 1999 to 2003

Year	Fatalities	Injuries @0.5%	PDO veh. @ 0.3%
1999	**34.20%**	17.10%	10.26%
2000	**33.80%**	16.90%	10.14%
2001	**36.50%**	18.25%	10.95%
2002	**33.00%**	16.50%	9.90%
2003	**36.6%**	18.29%	10.98%

As noted above, it has been estimated that about 10% of fatal crashes involve impairment by drugs (licit and illicit) alone. Assuming that the drugs-plus-alcohol frequencies are a sub-set of the instances where alcohol has been found[2], the estimations overall impairment can be drawn by multiplying the cells in Table 3 by 1.1

[2] As a combination of alcohol and drugs can be more impairing than the same level of alcohol alone, instances of undetected drugs-plus-alcohol may have alcohol levels too low to be included in any counts of impairment, as it is rare that drivers are examined for drugs. Consequently, this assumption is likely conservative. See Mercer & Jeffery, (1995).

Table 3: Estimated % Impaired - Fatalities, Injuries & PDO Vehicles, Canada, 1999 to 2003

Year	Fatalities	Injuries	PDO veh.
1999	37.62%	18.81%	11.29%
2000	37.18%	18.59%	11.15%
2001	40.15%	20.08%	12.05%
2002	36.30%	18.15%	10.89%
2003	40.25%	20.12%	12.07%

Finally, the estimated percent impaired (Table 3) can be applied to the estimated number of fatalities, injuries, and PDO vehicles (Table 1) to give an estimated number of victims and PDO vehicles, shown in Table 4.

Table 4: Estimated # Impaired - Fatalities, Injuries & PDO Vehicles, Canada, 1999 to 2003

Year	Fatalities	Injuries	PDO veh.
1999	1,247	73,579	243,185
2000	1,176	69,362	229,248
2001	1,213	71,563	236,522
2002	1,161	68,470	226,300
2003	1,257	74,181	245,174
All	**6,053**	**357,155**	**1,180,428**
Average	**1,211**	**71,431**	**236,086**

The insurance company-generated ratios of 1.2 fatalities per fatal crash, 1.11 injuries per fatal crash, 1.44 injuries per injury crash and 1.52 vehicles per PDO crash were used to move to the crash as the units of analysis, as shown in Table 5[3].

Table 5: Estimated # Impaired Crashes - Fatalities, Injuries & PDO, Canada, 1999 to 2003

Year	Fatal	Injury	PDO.	Sum
1999	1,039	50,295	159,990	**211,325**
2000	980	47,413	150,821	**199,214**
2001	1,011	48,917	155,606	**205,534**
2002	967	46,803	148,881	**196,652**
2003	1,048	50,707	161,298	1,048
All	**5,045**	**244,136**	**776,597**	**5,045**
Average	**1,009**	**48,827**	**155,319**	**1,009**

3. That is:
A. (number of fatalities divided by fatalities per fatal crash) = number of fatal crashes.
B. ((number of fatal crashes multiplied by number of injuries per fatal crash) subtracted from (number of injuries)) divided by number of injuries per injury crash = number of injury crashes
C. number of PDO vehicles divided by number of vehicles per PDO crash = number of PDO crashes

Using these crash frequency estimations, three costing models can be used (in 1999, 2000, 2001,2003 and 2003 dollars[4]) to estimate the order-of-magnitude of impaired-related crashes in Canada in each of these years.

Calculation of Costs:

Broadly, there are three kinds of questions that are asked about the result of a traffic crash:

1. How much will this cost me in real dollars spent? (Real Dollar Estimate -- RDE)
2. How much will this cost me in terms of lost goods, opportunity, or productivity? (Discounted Future Earnings --DFE)
3. How much would I pay for this not to have happened? (Willingness to Pay -- WTP)

Each model approaches the question of crash costs differently, especially in the calculation of the value of a fatal crash. The RDE figures are based on estimates from the Insurance Corporation of British Columbia (Mercer, & Halabisky, 1999), while the DFE and WTP estimates came from an Ontario study by Vodden et al. (1994).

Table 6: Crash costs by Costing Model in 1999 $

Model	fatal	injury-only	PDO
Real Dollar Estimate	$280,340	$25,215	$1,581
Deferred Future Earnings	$984,412	$23,779	$7,265
Willingness to Pay	$7,473,138	$32,101	$7,265

Using these models, in 1999, 2000, 2001 2003 and 2003 dollars, impaired-related crashes based on the above frequency estimations cost:

4 Inflation went from: 1999 to 2000 = 3.71% increase; 2000 to 2001 = 2.73% increase; 2001 to 2002 = 2.55%, and 2003 to 2003 = 2.16% increase. See http://www.bankofcanada.ca/en/inflation_calc.htm

Table 7: Crash costs by Costing Model in 1999 to 2003

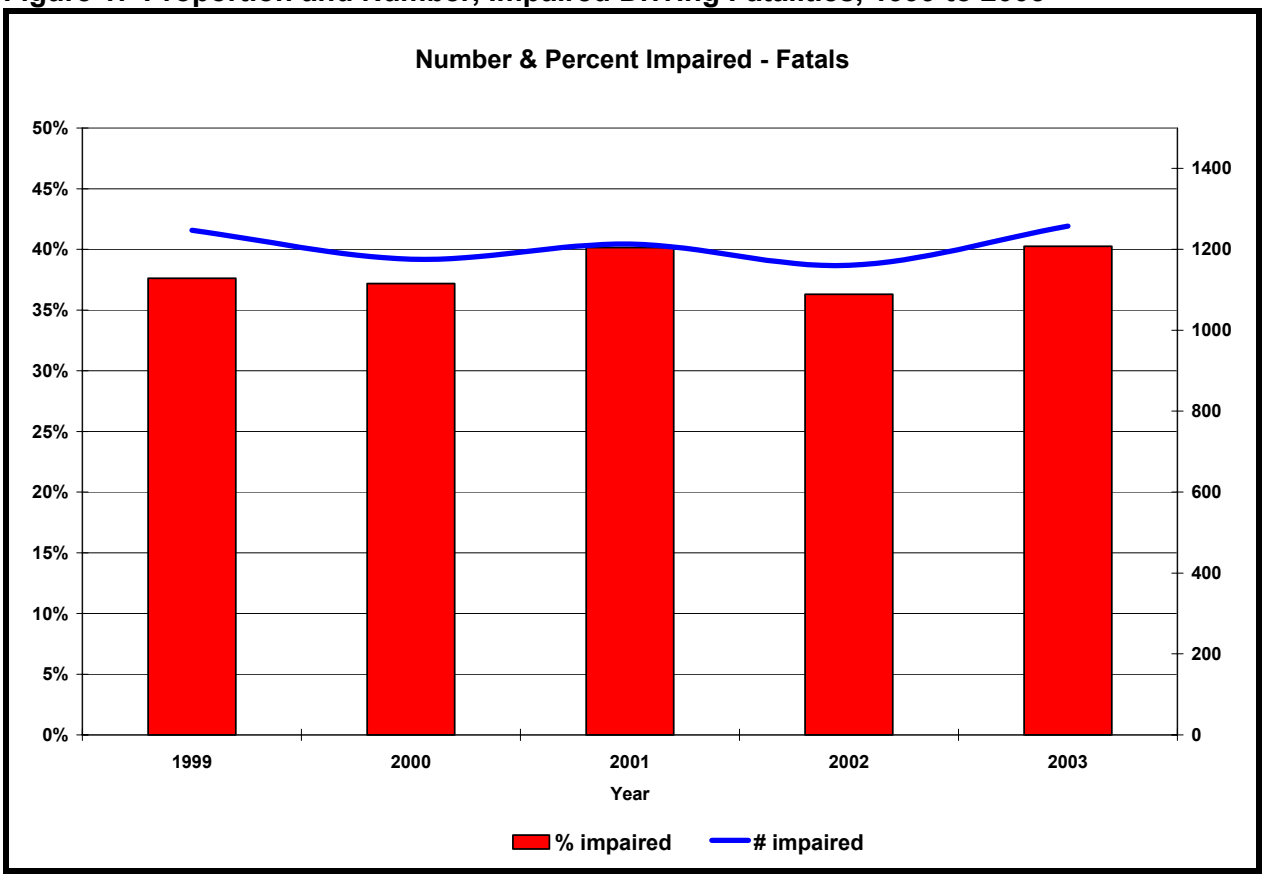
Year	Model	fatal	Injury-only	PDO	sum
1999	Real Dollar Estimate	$291,344,046	$1,268,200,800	$252,944,486	**$1,812,489,332**
	Deferred Future Earnings	$1,023,052,632	$1,195,976,475	$1,162,328,712	**$3,381,357,820**
	Willingness to Pay	$7,766,477,349	$1,614,535,550	$1,162,328,712	**$10,543,341,611**
2000	Real Dollar Estimate	$284,836,544	$1,239,874,089	$247,294,683	**$1,772,005,316**
	Deferred Future Earnings	$1,000,201,585	$1,169,262,977	$1,136,366,775	**$3,305,831,337**
	Willingness to Pay	$7,593,004,221	$1,578,473,057	$1,136,366,775	**$10,307,844,053**
2001	Real Dollar Estimate	$301,896,460	$1,314,134,739	$262,106,077	**$1,878,137,276**
	Deferred Future Earnings	$1,060,107,362	$1,239,294,466	$1,204,427,989	**$3,503,829,817**
	Willingness to Pay	$8,047,777,361	$1,673,013,653	$1,204,427,989	**$10,925,219,004**
2002	Real Dollar Estimate	$296,214,744	$1,289,402,617	$257,173,219	**$1,842,790,580**
	Deferred Future Earnings	$1,040,156,055	$1,215,970,844	$1,181,760,556	**$3,437,887,455**
	Willingness to Pay	$7,896,317,537	$1,641,527,400	$1,181,760,556	**$10,719,605,494**
2003	Real Dollar Estimate	$302,612,982	$1,317,253,713	$262,728,161	**$1,882,594,857**
	Deferred Future Earnings	$1,062,623,426	$1,242,235,814	$1,207,286,584	**$3,512,145,824**
	Willingness to Pay	$8,066,877,996	$1,676,984,392	$1,207,286,584	**$10,951,148,972**
All	Real Dollar Estimate	$1,476,904,776	$6,428,865,959	$1,282,246,627	**$9,188,017,362**
	Deferred Future Earnings	$5,186,141,059	$6,062,740,576	$5,892,170,617	**$17,141,052,252**
	Willingness to Pay	$39,370,454,464	$8,184,534,053	$5,892,170,617	**$53,447,159,134**
Ave-rage	Real Dollar Estimate	$295,380,955	$1,285,773,192	$256,449,325	**$1,837,603,472**
	Deferred Future Earnings	$1,037,228,212	$1,212,548,115	$1,178,434,123	**$3,428,210,450**
	Willingness to Pay	$7,874,090,893	$1,636,906,811	$1,178,434,123	**$10,689,431,827**

Conclusion:

The model developed in Estimating the Presence of Alcohol and Drug Impairment in Traffic Crashes and their Cost to Canadians: A Discussion Paper (Mercer & Marshall, 2002) was applied to data from Mayhew et. al. (2001) for 1999 data and to The Alcohol-Crash Problem in Canada (CCMTA) for the data for 2000, 2001 and 2002 to estimate the extent and cost of impaired driving in Canada.

Over the five-year period between 1999 and 2003, it is estimated that impaired driving killed **6,053** persons, injured **357,155**, and caused damage to **1,180,428** vehicles, translating into **5,045** fatal crashes, **244,136** injury-only crashes and **776,597** property-damage only (PDO) crashes, totaling **812,725** crashes in all.. In turn, this cost Canadians between **$9.2 billion** (Real Dollar Estimate model) and **$53.4 billion** (Willingness to Pay model) dollars, depending on the costing model and assumptions used. To put this another way, that represents a cost of between about **$293.00** and **$1,704.00** per Canadian.

Figure 1: Proportion and Number, Impaired Driving Fatalities, 1999 to 2003



While having only four years of data-points, the phenomenon appears to be relatively stable. For example, looking at the estimate of the proportion of fatalities from 1999 to 2003 they are 38%, 37%, 40%, 36% and 40% respectively, with no discernable trend. Admittedly, the drop from

2001 to 2002 represents about a 10% reduction in the total proportion[5], and 2002 is the lowest of the four years, but this may simply be a function of 2001 having been unusually high.

Because of this apparent stability, it seems reasonable to express these impaired driving statistics in terms of "average years". Thus, it is estimated that in an average year in Canada, impaired driving killed **1,211** persons, injured **74,181**, and caused damage to **245,174** vehicles, translating into **1,009** fatal crashes, **48,827** injury-only crashes and **155,319** property-damage only (PDO) crashes, totaling an average of **205,156** crashes in all.. In turn, on average, this cost Canadians between **$1.8 billion** (Real Dollar Estimate model) and **$10.7 billion** (Willingness to Pay model) dollars, depending on the costing model and assumptions used. To put this an other way, that represents a cost of between about **$59.00** and **$341.00** per Canadian.

Turning to 2003, the most recent year of data, it is estimated that, for Canada, impaired driving, including impairment by drugs other than alcohol, resulted in **3,124 fatalities**, **368,632 injuries** and, including property-damage-only, a total of **213,053 crashes,** at a cost of **between $1.9 and $11.0 billion dollars**, depending upon the costing model used.

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5 i.e., ((40% - 36%)/ 40%) * 100) = 10%

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