

RURAL ROAD SAFETY IN CANADA:

Traffic Collision Trends & Recommended Strategies

Prepared for

**CCMTA's Standing Committee
on Road Safety Research and Policies**

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1.0 Executive Summary

- Contrary to the findings of the Organization for Economic Cooperation and Development report entitled *Safety Strategies for Rural Roads*, which showed a worsening casualty trend on rural roads in recent years, Canada's rural road safety trend improved slightly during the 1985-1999 period.
- Like most other OECD member countries, Canada has no national rural road safety strategy, in large part because responsibility for road safety programs and road construction and improvements rests with non-federal jurisdictions.
- The three principal fatal crash configuration types from the OECD report – single-vehicle, intersection and head-on collisions – were also the most common configurations found in serious rural road crashes in Canada, although head-on crashes were considerably more prevalent in Canada.
- Many of the expected attributes of high-risk driver behavior were cited as contributing factors in rural collisions. However, the frequency with which some of these characteristics were noted as contributing factors was surprising. The more notable contributing factors were:
 - the prevalence of non-use of seat belts among drivers fatally injured in single-vehicle crashes (more than 60% non-use for all drivers aged 16-54 years, except for 20-24 year olds, where the rate of non-use was 56.8%);
 - the high incidence of unrestrained drinking drivers who were killed (78%) or seriously injured (74%) in single-vehicle nighttime crashes;
 - the large percentage of fatally injured drivers in intersection crashes who were 65 years of age or older (25.2%) and the high incidence of these elderly drivers who committed driving infractions in these crashes (77.7%);
 - the high incidence of drivers of all ages that were killed in intersection crashes who committed driving infractions (62.1%);
 - the high percentage of driver fatalities (44.0%) and serious injuries (49.8%) that occurred in collisions at intersections with no traffic controls;
 - the extremely high incidence of driver infractions committed among both fatally (74.1%) and seriously (73.7%) injured drivers involved in head-on collisions;
 - the relatively high incidence of driver fatalities (33.9%) and serious injuries (31.0%) that resulted from head-on collisions on curved sections of roads.

- The strategies proposed to make rural road travel safer include initiatives directed at improving the road network, making vehicles safer and changing road user behavior.
- The proposed strategies that focus on improvements to the road system include implementing a speed management program, improving the safety of road design and operations (e.g. rumble strips, intersection lighting or passing lanes) and better identifying safety problems.
- The proposed strategies aimed at making vehicles safer to travel in include in-vehicle intelligent transportation system devices.
- The proposed strategies targeted at rural road users, and drivers in particular, include public education and enforcement strategies aimed at increasing seat belt use, reducing drinking and driving, as well as decreasing the incidence of driving infractions.
- A modification of the trauma management system was also proposed to make emergency medical services more responsive to crash victims.
- Finally, improved data systems have been proposed. These include the use of automated collision data reporting, expanded use of geographic information systems, and the linking of crash and trauma databases to enhance knowledge of road, vehicle and road user characteristics.
- The strategies that have been identified in this report should be prioritized into short-, medium- and long-term activities. The prioritization process should incorporate realistic assessments of the likelihood of implementation in the majority of Canada's jurisdictions.
- A nationally representative task force should be created comprising key public and private sector stakeholders. The task force could raise awareness of key road safety problems unique to – or at least more prevalent on – rural roads, as well as develop strategies and initiatives on a national scale to address these issues, benefiting all jurisdictions.

2.0 Background

In December 1997, the Organization for Economic Cooperation and Development (OECD) identified rural road safety as a major problem among member countries. An expert group was created to quantify the problem. The ensuing report, *Safety Strategies for Rural Roads*, which was published in 1999, demonstrated that fatalities from crashes on rural roads (identified as “those roads outside of urban areas that are not motorways or unpaved roads”) were gradually increasing. Such fatalities had increased from fewer than 55% of total traffic fatalities in 1980 to more than 60% in 1996.

The report also identified three principal collision configuration types that accounted for approximately 80% of all fatal rural road collisions. These were single-vehicle incidents, particularly “run off the road” occurrences (at least 35% of fatal rural road crashes), head-on collisions (almost 25% of fatal collisions on rural roads) and collisions at intersections (approximately 20% of fatal crashes on rural roads).

The authors of the report also cited a general lack of explicit safety policies or targets designed for rural roads in most OECD member countries and recommended the implementation of short-, medium- and long-term interventions to address this gradually growing problem. Australia is an exception in this respect. It developed a safety action plan in the mid-1990s that focused on road and road user issues most critical to its rural population.

In Canada, the high number of fatalities and serious injuries occurring annually on rural undivided roadways was also identified as one its principal road safety problems. One of the areas targeted for fatality and serious injury reductions under Canada’s national road safety plan – Road Safety Vision 2010 – is rural roadways. The target calls for 40% decreases in the number of fatalities and serious injuries during the 2008-2010 period over the 1996-2001-baseline period. The most recent crash data (2004) show that fatalities and serious injuries account for 52% and 31% of total victims, respectively.

3.0 Report Objectives

The objectives of this report are twofold. The first objective is to closely examine elements from Transport Canada’s national Traffic Accident Injury Data (TRAID) file, focusing on the three main problem areas identified in the OECD report on rural road safety (single-vehicle, head-on and intersection crashes) and, if possible, to provide explanations for the casualty trends on rural roads.

The second objective of this paper is to identify potential strategies, based on the casualty trend analysis, to make rural road travel safer in Canada.

3.1 Data Limitations

While the OECD report focused on the changing distributions of crash data during the 1980-1996 period, the detailed examination of Canadian collision data focused on the period from 1995 to 1999 to offset any annual variations in the rural crash data. However, a long-term examination (1985-1999) of the shifts in serious casualties according to road class was also briefly conducted to ascertain if the changes in the distribution of serious crashes according to road class were the same in Canada as in most OECD member countries.

It was assumed that proportional distributions of known values for all data elements described in this profile were representative of those in jurisdictions where the information was not recorded or was reported as unknown. The unknown figures were representatively factored into the national totals. All data described in this report were generated from TRAIID.

3.2 Quantification of the Canadian Rural Road Safety Problem

While Canada is a highly urbanized country (77.9% urban, according to the 1996 Statistics Canada census¹), its overwhelming size, very low population density (3.2 persons per square kilometre) and the population's reliance on motor vehicles as a basic form of transportation make rural road travel a pervasive fact of life here. These demographic traits have contributed to the fact that a large number of fatalities and serious injuries occur on rural roads in Canada.

To determine if Canada's level of rural road safety had deteriorated in a similar fashion to what was described in other OECD member countries, the focus of the quantification of the rural road safety problem in Canada was on the three main types of collision described in the OECD report – single-vehicle, head-on and intersection collisions. Furthermore, only trends in serious casualties, defined as fatalities and serious injuries (minimum 24-hour stay in hospital), were examined.

4.0 Casualty Trends

4.1 Traffic Fatalities and Serious Injuries on All Roads – Canada, 1985-1999

Before we examine the three main problem areas in detail, a general overview of the rural road crash situation may be useful.

Like most highly industrialized countries, Canada recorded a dramatic improvement in road safety between 1985 and 1999, a period when annual fatality totals decreased by almost 32% and serious injuries were reduced by 35%. In most OECD countries, the percentage of fatalities and serious injuries that occurred on rural roads actually increased during the period. In Canada, however, the percentage of annual traffic fatalities and serious injuries that

¹ Statistics Canada defines an urban area as one where there is a population of at least 1,000 persons and where the population density per square kilometre is 400 or greater

occurred on rural roads (defined as roads with posted speed limits of 80-90 km/h) decreased slightly during the period. As Table 1 shows, the number of traffic fatalities and serious injuries that occurred on rural roads, as a percentage of all fatalities and serious injuries, decreased to 47.1% from 50.8% for fatalities and to 34.2% from 36.9% for seriously injured road users. The most notable percentage increases in road users killed or seriously injured occurred on motorways where posted speed limits were 100 km/h or higher.

The figures in Table 1 do not take into account the changes in travel patterns among motorists, which may have had an impact on the changing distributions of casualties. Unfortunately, estimates of annual vehicle kilometres travelled on each road type were not available for the period.

Table 1

**Distribution of Fatally and Seriously Injured Road Users
by Road Class (All Public Roads) - Canada - 1985 - 1999**

Killed Road Class	Year				Year			
	Number				Percent			
	1985	1990	1995	1999	1985	1990	1995	1999
Motorways	451	513	433	504	10.3	12.9	12.9	17.0
Rural	2214	2099	1691	1401	50.8	53.0	50.5	47.1
Urban Area	1697	1350	1227	1067	38.9	34.1	36.6	35.9
Total	4362	3962	3351	2972	100.0	100.0	100.0	100.0

Seriously Injured Road Class	Year				Year			
	Number				Percent			
	1985	1990	1995	1999	1985	1990	1995	1999
Motorways	2034	2294	1876	2041	7.5	9.1	8.7	11.6
Rural	9980	8879	7343	6004	36.9	35.3	34.2	34.2
Urban Area	15041	14009	12277	9533	55.6	55.6	57.1	54.2
Total	27055	25182	21496	17578	100.0	100.0	100.0	100.0

4.2 Traffic Fatalities and Serious Injuries on All Paved Roads – Canada, 1985-1999

In order to be consistent with the criteria used for the OECD report on rural road safety, this profile focused on victims of crashes that occurred on roads that were paved and had posted speed limits of 80-90 km/h. Table 2 shows these distributions. By comparing total casualties in Tables 1 and 2, it can be seen that slightly more than 90% of fatalities and serious injuries occurred in crashes on paved roads. While the percentages of fatalities and serious injuries differ slightly between the two tables, it can be seen that both have remained relatively unchanged during the 15-year period being examined.

Table 2

**Distribution of Fatally and Seriously Injured Road Users
by Road Class (All Paved Public Roads) - Canada - 1985 - 1999**

Killed	Year				Year			
	Number				Percent			
Road Class	1985	1990	1995	1999	1985	1990	1995	1999
Motorways	440	498	373	409	11.2	14.0	12.0	15.3
Rural	1940	1847	1604	1275	49.3	52.0	51.4	47.7
Urban Area	1553	1206	1144	990	39.5	34.0	36.7	37.0
Total	3933	3551	3121	2674	100.0	100.0	100.0	100.0

Seriously Injured	Year				Year			
	Number				Percent			
Road Class	1985	1990	1995	1999	1985	1990	1995	1999
Motorways	1967	2223	1624	1724	8.1	9.6	8.3	11.0
Rural	8272	7615	6672	5316	34.2	32.9	33.9	33.8
Urban Area	13919	13303	11386	8689	57.6	57.5	57.8	55.2
Total	24158	23141	19682	15729	100.0	100.0	100.0	100.0

4.3 Fatalities and Serious Injuries in Crashes on Paved Rural Roads – Canada, 1995-1999

4.3.1 Single-Vehicle Crashes

As previously stated, the OECD study on rural road safety found that three principal crash types occurred on rural roads – single-vehicle, intersection and head-on occurrences. These were the same three crash configurations that occurred most often on Canada's rural roads. Tables 3 through 5 provide victim information for the five-year period from 1995 to 1999.

Table 3 demonstrates that an average of 35.2% of all rural fatalities during the period were a result of single-vehicle crashes, virtually identical to the figures noted in the OECD report for single-vehicle crashes on rural roads (35%). Among seriously injured road users, an average of 44.4% during the five-year period sustained their injuries in single-vehicle occurrences on Canada's rural roads.

Table 3

**Distribution of Fatally and Seriously Injured Road Users on Paved Rural Roads
Single versus Multi-Vehicle Crashes - Canada - 1995-1999**

Killed	Year					Year				
	Number					Percent				
Crash Type	1995	1996	1997	1998	1999	1995	1996	1997	1998	1999
Single-Vehicle	552	507	462	458	444	34.4	35.2	34.9	36.8	34.8
Multi-Vehicle	1052	935	863	787	831	65.6	64.8	65.1	63.2	65.2
Total	1604	1442	1325	1245	1275	100.0	100.0	100.0	100.0	100.0

Seriously Injured	Year					Year				
	Number					Percent				
Crash Type	1995	1996	1997	1998	1999	1995	1996	1997	1998	1999
Single Vehicle	2931	2783	2613	2616	2389	43.9	44.1	43.6	45.6	44.9
Multi-Vehicle	3741	3531	3386	3118	2927	56.1	55.9	56.4	54.4	55.1
Total	6672	6314	5999	5734	5316	100.0	100.0	100.0	100.0	100.0

4.3.2 Intersection Crashes

During the five-year time frame examined, intersection crashes (Table 4) accounted for an average of 21.9% of fatalities on rural roads and 27.9% of victims seriously injured in these crashes. The fatality figure is quite consistent with the average observed among all OECD member countries (20%). Table 4 also demonstrates that, at least in the short term, the percentage contribution of intersection crashes to fatal injuries on rural roads seems to be increasing, as the 1998 and 1999 distributions were noticeably higher than during the previous years examined.

Table 4

**Distribution of Fatally and Seriously Injured Road Users by Road Configuration
All Paved Rural Roads - Canada - 1995-1999**

Killed	Year					Year				
	Number					Percent				
Road Configuration	1995	1996	1997	1998	1999	1995	1996	1997	1998	1999
Intersection	339	302	264	298	306	21.1	20.9	19.9	23.9	24.0
All Other Configurations	1265	1140	1061	947	969	78.9	79.1	80.1	76.1	76.0
Total	1604	1442	1325	1245	1275	100.0	100.0	100.0	100.0	100.0

Seriously Injured	Year					Year				
	Number					Percent				
Road Configuration	1995	1996	1997	1998	1999	1995	1996	1997	1998	1999
Intersection	1927	1645	1648	1627	1544	28.9	26.1	27.5	28.4	29.0
All Other Configurations	4745	4669	4351	4107	3772	71.1	73.9	72.5	71.6	71.0
Total	6672	6314	5999	5734	5316	100.0	100.0	100.0	100.0	100.0

4.3.3 Head-on Crashes

In Canada, head-on crashes accounted for more than one in three rural road fatalities (an average of 34.6%) and one in five seriously injured rural road users (an average of 20.2%) during the five-year period. This fatality figure is considerably higher than the figure cited in the OECD report for fatal head-on crashes on rural roadways (approximately 25%).

As shown in Table 5, fatalities resulting from rural head-on crashes have decreased considerably during the five years examined. These reductions may be due in some part to the longer-term positive effects of daytime running lights, which were introduced on all new vehicles beginning in 1990. However, it must be noted that during 1999, when the largest decrease was observed, one jurisdiction changed the manner in which it reported crash information for a particular data element. This modification did have an impact on the recorded number of road users killed in head-on crashes for that year.

Table 5

**Distribution of Fatally and Seriously Injured Road Users by Crash Configuration
All Paved Rural Roads - Canada - 1995-1999**

Killed	Year					Year				
	Number					Percent				
Crash Configuration	1995	1996	1997	1998	1999	1995	1996	1997	1998	1999
Head-on	614	506	453	435	378	38.3	35.1	34.2	34.9	29.6
All Other Configurations	990	936	872	810	897	61.7	64.9	65.8	65.1	70.4
Total	1604	1442	1325	1245	1275	100.0	100.0	100.0	100.0	100.0

Seriously Injured	Year					Year				
	Number					Percent				
Crash Configuration	1995	1996	1997	1998	1999	1995	1996	1997	1998	1999
Head-on	1376	1435	1293	1042	918	20.6	22.7	21.6	18.2	17.3
All Other Configurations	5296	4879	4706	4692	4398	79.4	77.3	78.4	81.8	82.7
Total	6672	6314	5999	5734	5316	100.0	100.0	100.0	100.0	100.0

5.0 Characteristics of the Rural Road Safety Problem

The tables presented thus far have identified the magnitude of the rural road safety problem in Canada and have shown that the main rural collision issues noted in other OECD member countries also apply to the Canadian situation. However, a closer examination of driver behaviour, road environment (infrastructure) issues and vehicle characteristics will provide a clearer focus for the strategies proposed to make travel on rural roads safer.

This summary examination focused on driver behaviour, vehicle characteristics and road characteristics for single-vehicle crashes; and on driver behaviour and road characteristics for head-on and intersection crashes.

This section presents percentage figures only, as national totals were not available. It must be mentioned that some of the figures used to generate the percentages were quite small. However, it is also worth noting that the percentages cited in this section are average figures based on data over the 1995-1999 period, which should take into account year-over-year variations.

6.0 Single-Vehicle Crashes: Key Findings

While the figures presented in the following sections do not include information from all jurisdictions, for this study they were assumed to be representative of the entire country. Saskatchewan and Alberta figures were excluded from all tables for the entire report, as were Quebec figures from a number of tables, because certain key data elements from those jurisdictions were not included in TRRID.

The examinations of the driver, vehicle and road/environmental characteristics of single-vehicle occurrences were undertaken from the perspective of statistics on fatally and seriously injured drivers, so that the strategies recommended to address specific problem areas could reflect the most frequently cited road user and victim concerns. It must also be pointed out that key findings did not emanate from all of the data elements examined. However, statistical tables summarizing the results of the analyses are found in the Appendix. The same protocols were followed when examining trends regarding intersection and head-on crashes.

6.1 Driver Characteristics

Most of the traits found among fatally injured drivers involved in rural single-vehicle crashes during the five-year period examined (1995-1999) were expected. However, the percentage of these crashes that did involve high-risk driving behaviour was still alarming.

Driver Condition (see Table SV1 in the Appendix):

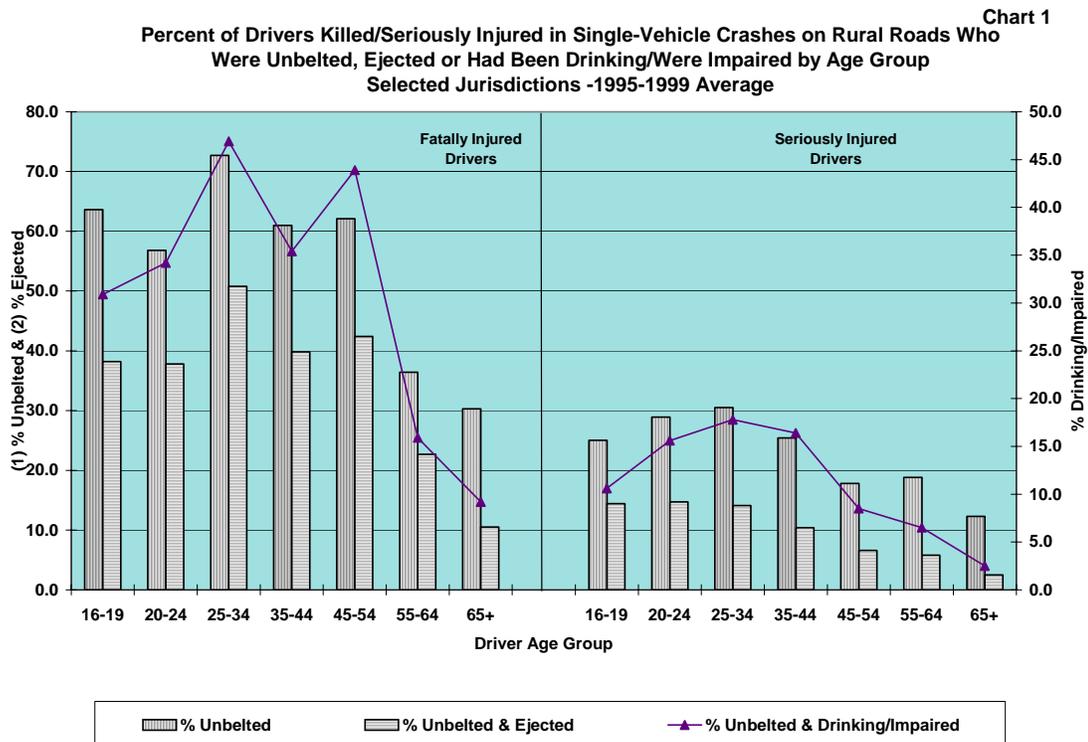
- Almost 45% of fatally injured drivers had been drinking or were legally impaired by alcohol or drugs (all alcohol use figures cited in this report are minimum estimates).
- 25-34 year olds had the highest incidence of driving under the influence, at 60%, followed closely by 20-24 year olds (56.1%).

Excessive or Inappropriate Speed (see Table SV2 in the Appendix):

- More than one-third (34.9%) of fatally injured drivers were driving too fast for the conditions or exceeding the speed limit.
- Speed-related fatalities were most prevalent among younger drivers – those aged 16-19 years (49.9%) and 20-24 years (46.6%).

Restraint Use (see Table SV4 in the Appendix):

- Non-use of seat belts was the characteristic most often found among fatally injured victims of single-vehicle crashes on rural roads.
- With the exception of victims aged 20-24 years old, where the non-use rate of seat belts was slightly lower (56.8%), more than 60% of all fatally injured drivers between the ages of 16 and 54 years were unbelted at the time of crash occurrence.
- Ejection rates ranged from 38% to 50% among this group of unbelted fatally injured drivers (those aged 16-54 years).



6.2 Vehicle Characteristics

Vehicle Type (see Tables SV5A & B in the Appendix):

- Among drivers who were killed in single-vehicle crashes, non-use of seat belts was highest among victims who were driving light trucks or vans (69.6% over the five-year period) and commercial vehicles (70.6%). However, it must be mentioned that heavy-goods vehicles accounted for a very small percentage (approximately 4%) of the vehicles involved in these crashes. Half (49.8%) of the car drivers killed in these crashes were unrestrained.

Vehicle Event (see Table SV6 in the Appendix):

- Approximately 70% of drivers killed and almost 76% of those seriously injured incurred their injuries following non-collision events (running off the roadway, overturning, skidding or sliding, etc.)

6.3 Road/Environmental Characteristics

While the charts and discussion in the following section focus on road and environmental characteristics, it must be reiterated that these were examined from the perspective of information on fatally and seriously injured drivers.

Light Conditions (see Tables SV7A, B & C in the Appendix):

Among fatally and seriously injured drivers:

- The devastating effects of non-use of seat belts and driving after drinking are clearly evident among victims of nighttime crashes.
- The majority of unbelted fatally and seriously injured drivers sustained their injuries in crashes that occurred during dark/artificial road lighting conditions (66.3% and 58.4%, respectively).
- An overwhelming majority of fatally and seriously injured drivers who were unbelted and had been drinking or were impaired sustained their injuries in nighttime crashes with dark/artificial road lighting conditions (78.0% and 74.7%, respectively).

Road Alignment (see Table SV10 in the Appendix):

Among drivers who were killed:

- Almost half (47.2%) died in crashes that occurred on sections of road that were curved, either level or with a grade.

Among drivers who were seriously injured:

- 39.6% sustained their injuries in crashes that occurred on sections of road that were curved, and were either level or had a grade.

7.0 Intersection Crashes: Key Findings

Intersection-related crashes include those that occurred at the intersection of at least two public roadways, intersections related by traffic control influence or intersections with private driveways or laneways. As was the case for the examination of single-vehicle crashes on rural roads, the detailed examination of driver and road/environmental characteristics of intersection crashes was conducted from the drivers' perspective to facilitate the link between victim information and proposed strategies.

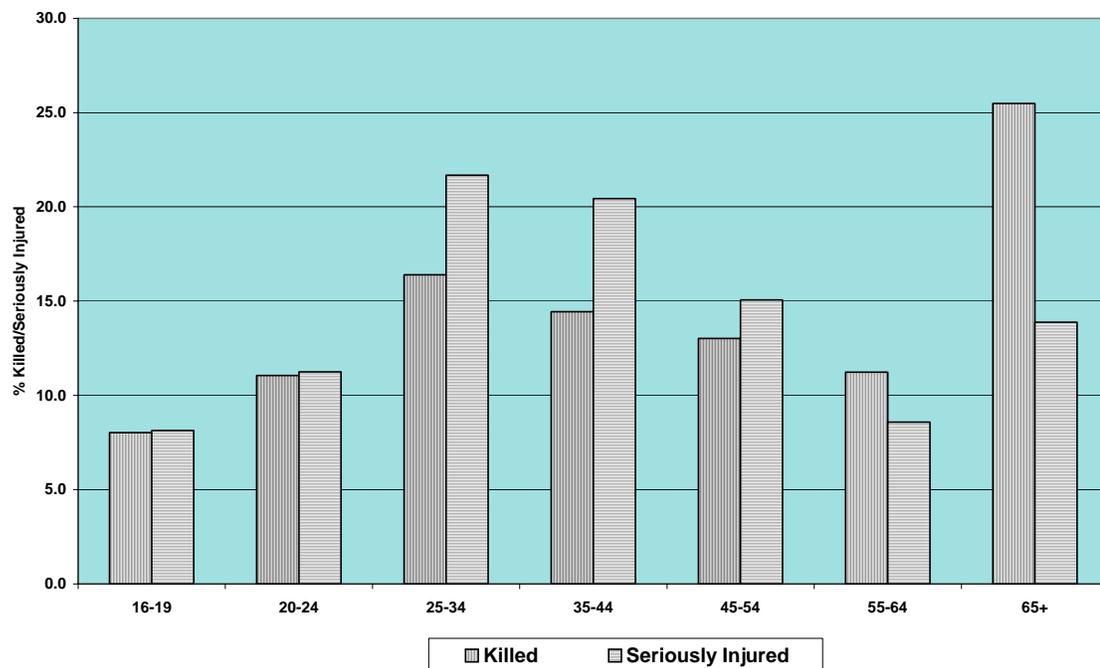
7.1 Driver Characteristics

Driver Age (see Table IC1 in the Appendix):

Among drivers fatally injured in intersection crashes on rural roads:

- One of the most alarming findings was the large percentage (25.5%) of fatally injured drivers who were 65 years of age or older (see Chart 2). This considerable over-representation of older drivers (Canada's 65 and older population comprises slightly more than 12% of the population and of licensed drivers) may be an indication that older drivers have difficulty making correct driving decisions at intersections. Alternatively, it may simply be the case that older drivers are more frail and consequently more likely to die in a serious crash, regardless of the collision configuration. There was a more representative distribution of drivers aged 65 years or older among seriously injured drivers (13.9%).

Distribution of Drivers Fatally or Seriously Injured in Intersection-Related Rural Road Crashes by Driver Age Groups - Selected Jurisdictions - 1995-1999 Average **Chart 2**

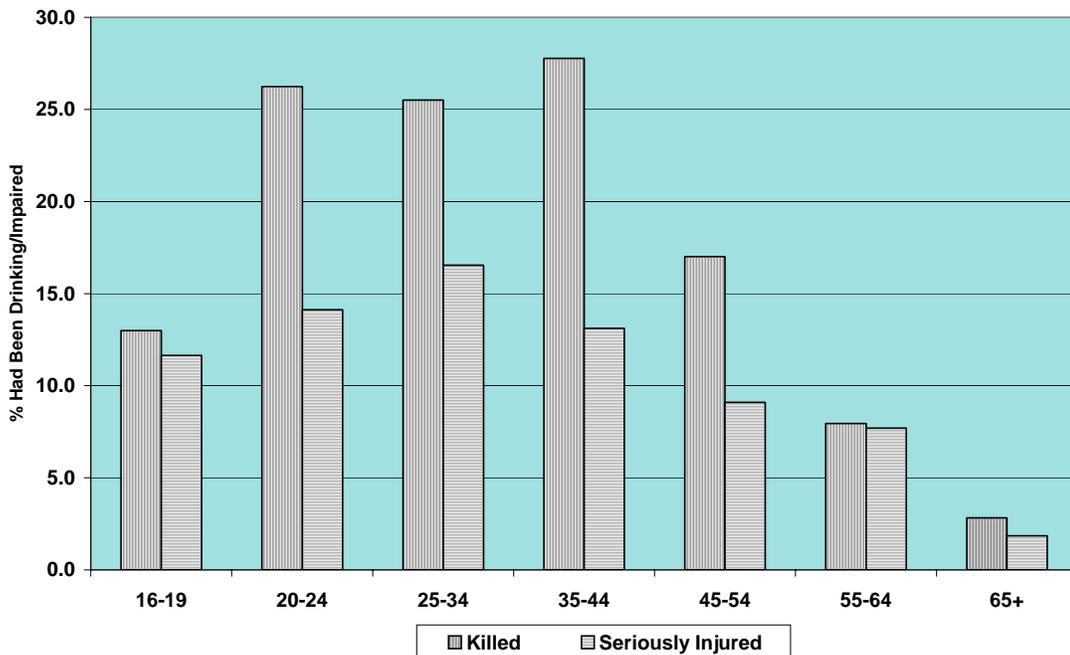


Driver Condition (see Table IC2 in the Appendix):

While alcohol use was a contributing factor among all age categories of fatally and seriously injured drivers involved in intersection-related rural crashes, it was considerably less prevalent than among victims of single-vehicle rural road crashes. Overall, an average of 15.9% (minimum figures) of fatally injured drivers and 11.2% of those seriously injured had been drinking or were legally impaired during the five years examined.

Chart 3

Drivers Killed/Seriously Injured In Intersection-Related Crashes on Rural Roads Who Had Been Drinking/Were Impaired by Age Group - Selected Jurisdictions - 1995-1999 Average



Driver Action (see Tables IC3A & B in the Appendix):

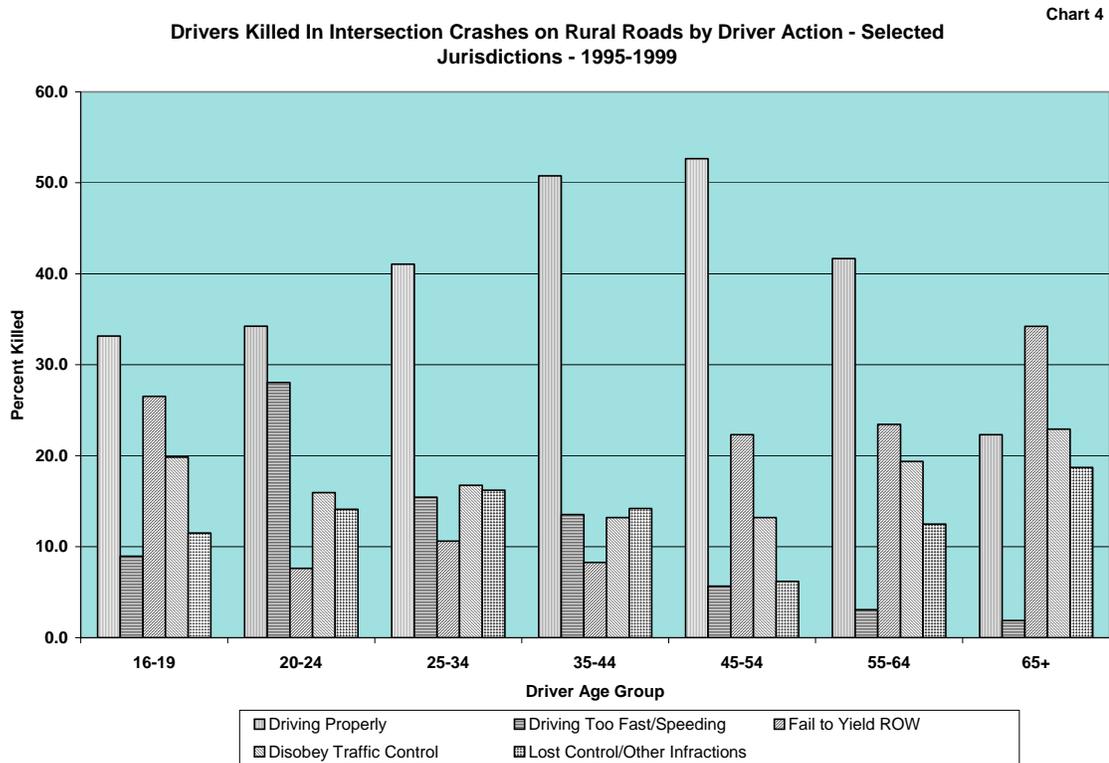
Among drivers that were killed:

- 62.1% committed a driving infraction (assuming drivers who "lost control" were driving improperly) prior to the collision occurrence.
- The most often reported driving infractions were failing to yield the right-of-way (21.2%) and disobeying traffic controls (17.6%).
- Older drivers (65 or older) committed driving infractions (77.7%) more frequently than any other age category. The most often cited driving infractions among fatally injured older drivers were failing to yield the right-of-way (34.2%) and disobeying traffic controls (22.9%).

Among seriously injured drivers:

- Approximately half (50.3%) were driving improperly when the collision occurred.
- Again, failing to yield the right-of-way and disobeying a traffic signal (15.2% and 11.5%, respectively) were the two most often reported driving infractions.

- Older drivers (65+ years) and the youngest drivers (16-19 years) were the age groups of motorists that were most likely to be driving improperly (62.8% and 63.6%, respectively).
- Among the aged, failing to yield the right-of-way was again the most often reported infraction (28.8%).
- Among novice drivers, disobeying a traffic control was the most often cited infraction (16.2%).



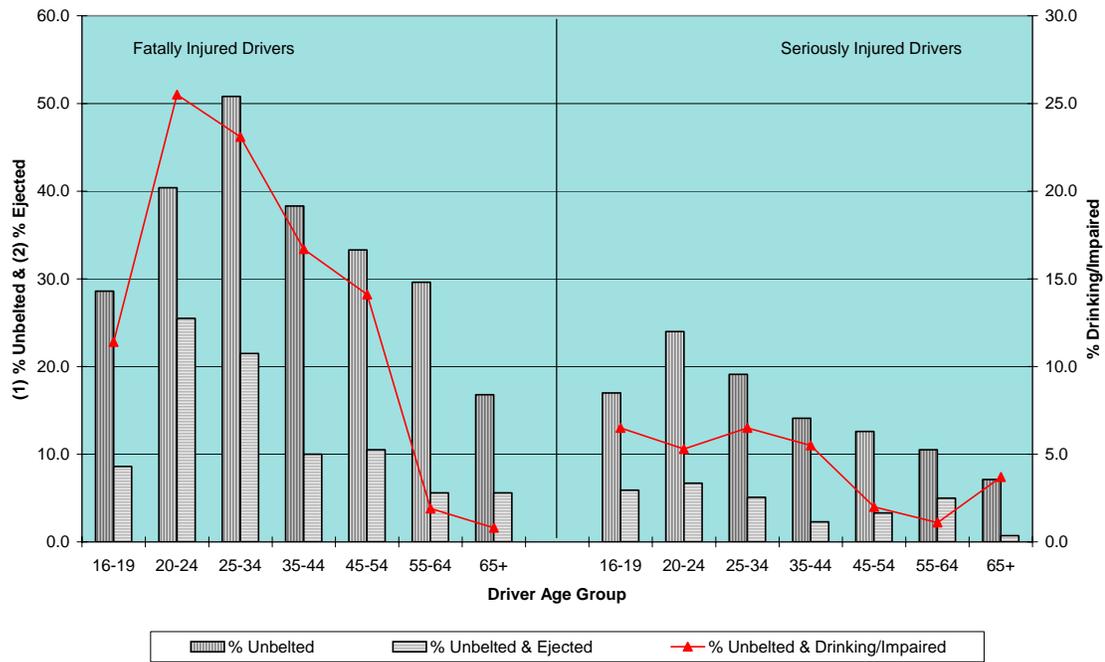
Driver Restraint Use (see Table IC5 in the Appendix):

Among fatally injured drivers:

- 31.8% were unbelted at the time of the occurrence.
- A relatively strong relationship existed between non-use of restraints and alcohol consumption. This link was most evident among fatally injured drivers in the 20-24 and 25-34 year old age categories (see Chart 5).

Percent of Drivers Killed/Seriously Injured in Intersection Crashes on Rural Roads Who Were Unbelted, Ejected or Had Been Drinking by Age Group Selected Provinces - 1995-1999

Chart 5



7.2 Vehicle Characteristics

Vehicle Manoeuvre (see Table IC6 in the Appendix):

Among fatally injured drivers:

- As expected, most were driving their vehicle straight ahead (70.0%), but almost one in five (19.0%) were turning left prior to the collision occurrence.

Among seriously injured drivers:

- A slightly larger distribution of drivers was going straight ahead (73.3%), while a slightly smaller distribution was turning left (14.4%).

7.3 Road/Environmental Characteristics

Road Alignment (see Table IC8 in the Appendix):

- Almost one in five drivers killed (19.4%) and one in six drivers seriously injured (16.9%) incurred their injuries at intersections where there were curves, which may be an indication that conspicuity was an issue.

Traffic Controls (see Table IC9 in the Appendix):

- Intersections where no controls were present yielded the largest percentage of victims killed or hospitalized (44.0% and 49.8%, respectively).

8.0 Head-On Collisions: Key Findings

With one exception (Table HO3 examines all road users killed or seriously injured, not just drivers), the key findings presented in the following section focus on head-on collisions on rural roads that resulted in driver fatalities or serious injuries.

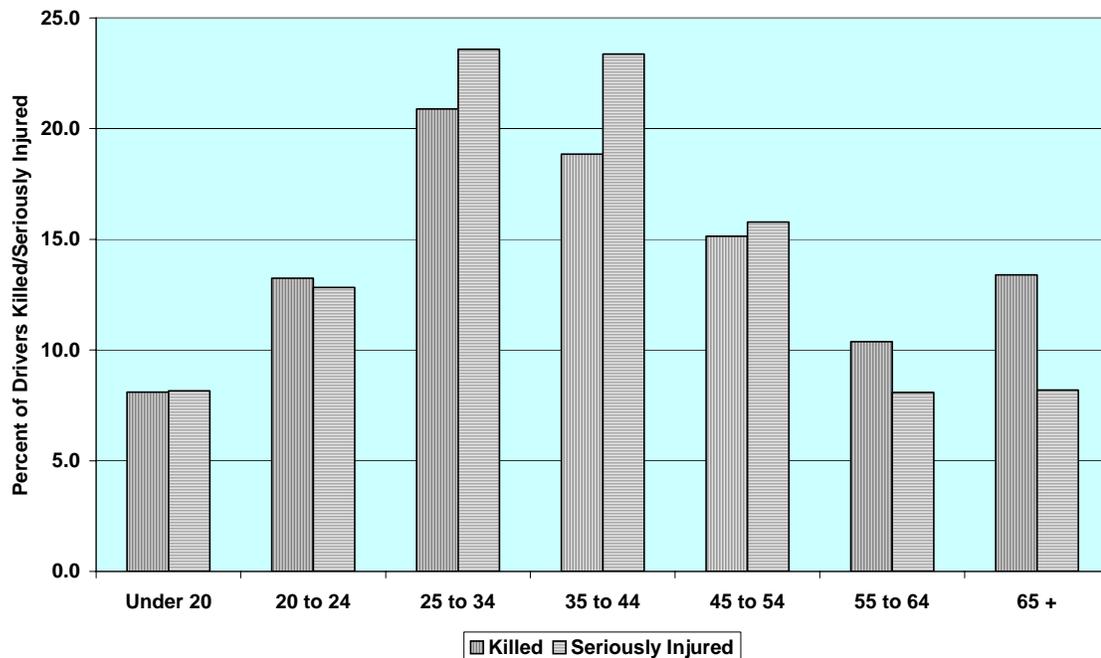
8.1 Driver Characteristics

Driver Age (see Table HO1 in the Appendix):

Among fatally and seriously injured drivers:

- The under 20 and 20-24 year old age group of drivers were considerably over-represented as victims when compared with the percentage of licensed drivers they represented.

Distribution of Drivers Killed/Seriously Injured in Head-on Crashes on Rural Roads by Driver Age Group - Selected Provinces - 1995-1999 Chart 6



Driver Gender (see Table HO2 in the Appendix):

- Male drivers accounted for disproportionately larger percentages of fatalities and serious injuries (69% and 64%, respectively) than of licensed drivers (53%). This disparity may in part be the result of riskier driving behaviours by males or the considerably higher number of vehicle kilometres travelled each year by males than females.

Road User Classification (see Table HO3 in the Appendix):

- The vast majority of victims killed (more than 95%) were motor vehicle occupants, followed distantly by motorcyclists (2.9%). Although it is not obvious from the figures found in Table HO3, a somewhat surprising statistic was that 40.3% of total motorcyclist fatalities during the 1995-1999 period occurred as a result of head-on crashes on rural roads.

Driver Restraint Usage and Ejection Status (see Table HO4 in the Appendix):

- 23.2% of fatally injured drivers in head-on collisions on rural roads were unrestrained at the time of the collision, and of these victims, 22.7% were partially or fully ejected from their vehicle during the crash.

Driver Condition (see Table HO5 in the Appendix):

Among fatally injured drivers:

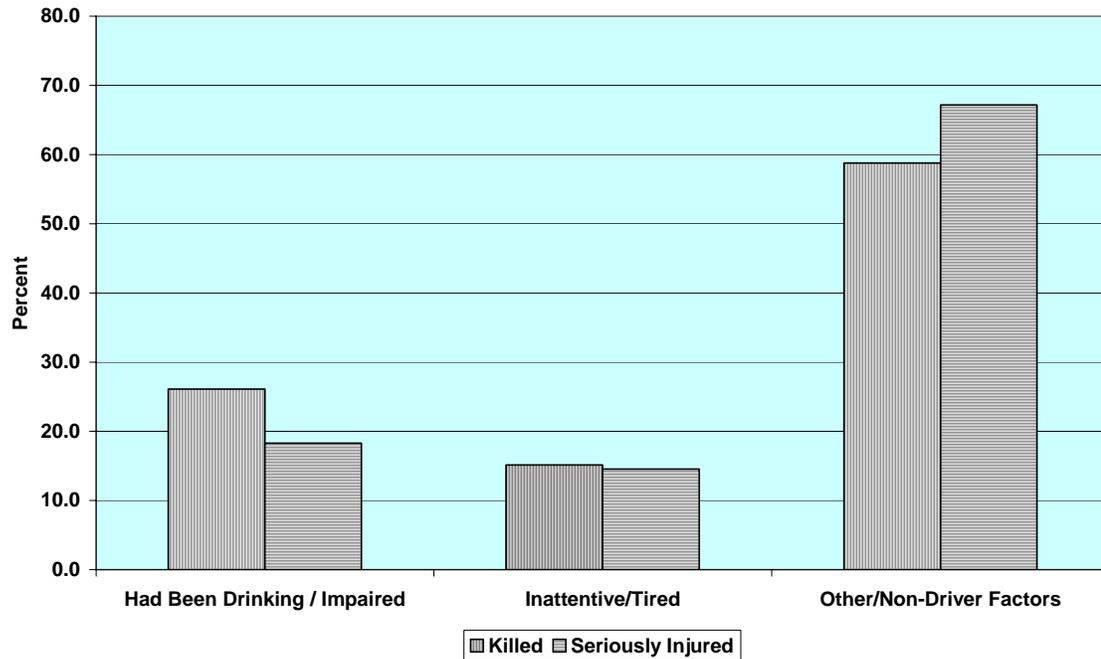
- Driver condition was cited as a contributing factor in 41.2% of the incidents that resulted in dead drivers. "Had been drinking/impaired" driving (26.1%, minimum estimate) and "inattention" or "tiredness" (15.2%) were the most often cited factors that may have contributed to the crashes.

Among seriously injured drivers:

- The two most often cited conditions that may have contributed to the crashes were "had been drinking/impaired" (18.3%) and "inattentive/tired" (14.5%).

Drivers Killed/Seriously Injured in Head-on Crashes on Rural Roads According to Driver Condition - Selected Jurisdictions - 1995-1999

Chart 7

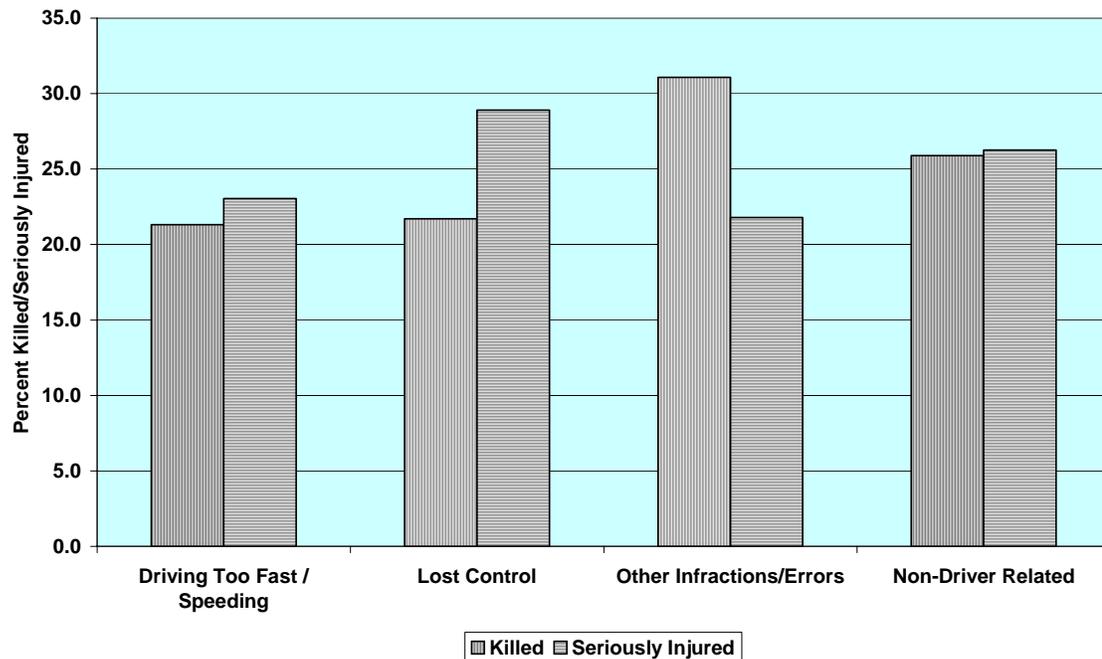


Driver Action (see Table HO6 in the Appendix):

Among fatally and seriously injured drivers:

- Approximately 74% had committed a driving infraction or error prior to being involved in the head-on crash.
- "Loss of control," which assumes driver infractions or errors had been committed, and "driving too fast/speeding" were the two most often cited driver infractions.

Drivers Killed/Seriously Injured in Head-on Crashes on Rural Roads According to Driver Action - Selected Jurisdictions - 1995-1999



8.2 Road/Environmental Characteristics

Road Alignment (see Table HO9 in the Appendix):

- Approximately one-third of driver casualties (34.6% of those killed and 31.2% of those seriously injured) resulted from crashes on curved sections of roadway. These relatively large victim figures suggest that high-risk driving behaviours probably occurred among many of these involved drivers prior to the head-on collision.

Road Surface Conditions (see Table HO12 in the Appendix):

- Almost half (45.4%) of drivers fatally injured in head-on crashes were killed on roads that were described as either snow/slush/ice covered (26.4%) or wet (19.0%).
- More than half (56.7%) of seriously injured drivers sustained their injuries on road surfaces that were either snow/slush/ ice covered (41.1%) or wet (15.6%).

9.0 Rural Road Safety Strategies

Having quantified the rural road safety problem in Canada and examined the more obvious characteristics of the most common crash types occurring on rural roads, this report will now identify a number of short-, medium- and long-term strategies to make rural road travel as safe as possible. These strategies however have not yet been prioritized.

These strategies encompass:

1. Improved Data
2. Better Identification of Safety Problems
3. Improved Safety of Road Design and Operations
4. Enforcement Strategies and Public Education
5. Speed Management Program
6. Intelligent Transportation System (ITS) Measures
7. Trauma Management System

These strategies seek to achieve:

- a reduction in the percentage of fatalities and serious injuries that occur in the rural areas of Canada by 40%;
- greater public awareness of the socio-economic costs of rural road safety issues;
- improvements in attitude and behaviour of rural road users;
- reductions of known deficiencies in road design and construction;
- coordination of programs at all levels of government.

1. IMPROVED DATA

Activities	Lead Agency / Supporting Agencies
Automatic collision data collection	Transport Canada / Provinces & Territories / Police
Expanded use of Geographic Information Systems (GIS)	Transport Canada / Provinces & Territories
Improved linkages among safety-related databases	Transport Canada / Provinces & Territories

2. BETTER IDENTIFICATION OF SAFETY PROBLEMS

Activities	Lead Agency / Supporting Agencies
Local black-spot programs	Provinces & Territories / Local governments; Police
Network Screening (3R/4R)	Provinces & Territories / Local governments
National black-spot program	Transport Canada / Provinces & Territories
In-Service Road Safety Reviews & Road Safety Audits	Transportation Association of Canada (TAC) / Provinces & Territories / Local governments

3. IMPROVED SAFETY OF ROAD DESIGN AND OPERATIONS

Activities	Lead Agency / Supporting Agencies
Continuous shoulder / centreline & transverse rumble strips	TAC / Transport Canada / Provinces & Territories
Improved traffic control devices	TAC / Provinces & Territories / Transport Canada
Modern Roundabout intersection design	TAC / Provinces & Territories / Transport Canada
Access management	TAC / Provinces & Territories / Transport Canada
Intersection lighting	TAC / Provinces & Territories / Transport Canada
Passing lanes	Provinces & Territories / Transport Canada

4. ENFORCEMENT STRATEGIES AND PUBLIC EDUCATION

Activities	Lead Agency / Supporting Agencies
Rural seat belt surveys / Education	Transport Canada / Provinces & Territories

Rural seat belt ad campaign	Canadian Council of Motor Transport Administrators (CCMTA) National Occupant Restraint Program (NORP) 2010 / Provinces & Territories / Transport Canada
Child restraints (e.g. <i>Car Time 1-2-3-4</i> , surveys)	Transport Canada / Provinces & Territories
Rural impaired driving enforcement	CCMTA Strategy to Reduce Impaired Driving (STRID) 2010 / Provinces & Territories / Transport Canada
Involve local communities (e.g. Southern Alberta Rural Seat Belt Survey)	Provinces & Territories / Transport Canada / Police

5. SPEED MANAGEMENT PROGRAM

Activities	Lead Agency / Supporting Agencies
Ensure uniform application of speed limits for similar conditions through a speed management expert system (CANLIMIT)	TAC / Provinces & Territories
Identify high-risk drivers who drive at excessive speeds above the posted speed limits	CCMTA / Provinces & Territories
Implement strategic targeted enforcement programs (e.g. Southern Alberta Demonstration Project)	RCMP / Canadian Association of Chiefs of Police (CACP) / Transport Canada / Provinces & Territories

6. INTELLIGENT TRANSPORTATION SYSTEM (ITS) MEASURES

Activities	Lead Agency / Supporting Agencies
Speed advisory systems	Provinces & Territories / Local governments
Road Weather Information Systems (RWIS)	Provinces & Territories / Local governments
On-board vehicle systems	Motor vehicle industry / Transport Canada

7. TRAUMA MANAGEMENT SYSTEM

Activities	Lead Agency / Supporting Agencies
Improved Location Identification	Provinces & Territories
Improved emergency medical services	Provinces & Territories / Health Canada
In-vehicle GPS locators (e.g. Navstar)	Motor vehicle manufacturers

The rationale for the implementation of these strategies is discussed below.

1. IMPROVED DATA

- **Automatic Collision Data Collection**

The collection of collision data is currently an onerous task for enforcement personnel. Expanding the existing collision data report forms to include additional data required by researchers would not be viewed positively. One method of reducing the effort required is the use of electronics for the automatic capture of data such as driver and vehicle information.

In partnership with selected provincial governments and police agencies, Transport Canada is conducting a demonstration project of a computer and communications-based system called the Traffic and Criminal Software System (TRaCs). This software is designed for multi-jurisdictional use and was built in modules, allowing for great flexibility. It has many potential uses, including the automated on-site collection of all traffic collision data, ticketing and commercial vehicle inspection. The demonstration project is designed to verify the flexibility of the software and its application within several police-operated record management systems and computer-assisted dispatch systems. It is intended to provide a national focus for the development of uniform automated data collection performance standards, including integration with driver and vehicle registration databases.

- **Expanded Use of Geographic Information Systems (GIS)**

Geographic Information Systems offer a promising new technology for locating, viewing and analyzing collision data. Using a spatial referencing system, other databases can also be linked to collision databases using the same location coordinates. The province of New Brunswick has implemented GIS, while Nova Scotia and other provinces are investigating the implementation of these systems.

The Federal Highway Administration uses the GIS platform to manage data on their National Highway System. The U.S. Bureau of Transportation Statistics also uses GIS to manage their national safety data.

- **Improved Linkages Among Safety-Related Databases**

One of the key databases of benefit to researchers is trauma data. The Canadian Institute for Health Information and Transport Canada are undertaking research aimed at improving the linkages between trauma data and collision data to better identify trauma severity levels associated with various collision configurations. These linkages will enable researchers to determine if particular types of injuries and injury severity levels are associated with specific types of crashes.

2. BETTER IDENTIFICATION OF SAFETY PROBLEMS

- **Local Black-Spot Programs**

The first step in addressing safety problems is usually to keep track of those locations where more than the average number of collisions is occurring.

The term "black spot" is derived from the practice of inserting pins in a large wall map indicating the location of collisions. Black pins were usually used for fatalities, another colour for injuries, and another colour for PDOs or "property damage only." While the use of pins and wall maps is no longer common, having been replaced by computer data files, the terminology has remained.

Once the high-collision locations have been identified, their treatment is usually prioritized according to the number of fatalities. Other strategies are to prioritize according to the number of casualties (fatalities plus serious injuries) or the number of collisions.

- **Network Screening (3R/4R)**

Similar to the Black Spot Program, Network Screening is a process that reviews all collisions on the roadway network and compares locations of similar design and operation characteristics to identify those locations with higher than average collision experience. There is considerable cost-effectiveness in scheduling safety improvement work as a part of a transportation agency's activities such as Repaving, Rehabilitation and Restoration (3R) as well as including Reconstruction (4R) at those locations.

- **National Black-Spot Program**

The national program would primarily be focused on the National Highway System and collision experience across the country. As with local programs, the specific measures of total collisions, casualties or fatalities would have to be agreed upon.

- The Canadian Highway Information System being developed by Transport Canada, using a national topographical map and GIS, will assist in identifying black spots of national significance.

- **In-Service Road Safety Reviews & Road Safety Audits**

After identifying the high-collision locations, it is necessary to examine the causes and the potential countermeasures to be implemented. A safety evaluation, or In-Service Road Safety Review is one approach. A team of investigators reviews the collision report, visits the site to identify factors that may have influenced the collision, and makes recommendations as to how to improve the safety of the situation.

A more proactive approach to reduce or eliminate safety problems for roads, which have not yet been built, is the Road Safety Audit procedure.

“The Canadian Guide to In-Service Road Safety Reviews”, TAC, 2003 and *“The Canadian Road Safety Audit Guide”*, TAC, 2001 provide guidance on how to carry out these safety analyses.

3. IMPROVED SAFETY OF ROAD DESIGN AND OPERATIONS

- **Continuous Shoulder / Centreline and Transverse Rumble Strips**

Continuous shoulder rumble strips have been found to be one of the most cost-beneficial treatments for single-vehicle run-off collisions, with benefit-cost ratios ranging from 30:1 to 60:1. It is estimated that rumble strips can reduce the rate of run-off-road crashes between 20% and 50%. The 2001 TAC report *“Synthesis of Best Practices For The Implementation of Shoulder and Centreline Rumble Strips”* recommended that a Collision Modification Factor of 0.70 (30% reduction) be adopted.

Centreline rumble strips are intended to prevent head-on and sideswipe-type collisions with opposing traffic. While the number of lane kilometres of centreline rumble strips has been increasing since 1999, these rumble strips are still in the experimental stage. A 2003 study by the Insurance Institute for Highway Safety concluded that they reduced head-on and opposing-direction sideswipe collisions by an estimated 21%. Based on these findings, a 2005 TAC report *“Synthesis of Practices for the Implementation of Centreline Rumble Strips”* was produced. Alberta Infrastructure and Transportation is planning on installing centerline rumble strips on all roadway curves where passing is prohibited in both directions.

Transverse rumble strips (TRS) are placed across the traveled lane to warn of dangerous locations such as an upcoming intersection that may have poor sight distance. TRS are an extraordinary traffic control measure when all other usual treatments such as signing, lane markings, and improvements to the geometric layout cannot eliminate the highly probable element of unexpectedness in the driving environment. A guide to where and when to use TRS was recently completed in TAC *“Best Practice Guidelines for the Design and Application of Transverse Rumble Strips”*, 2005.

- **Traffic Control Devices**

Standard-size traffic signs are designed mainly for urban intersections and urban speeds. Higher-speed intersections in rural areas should have larger traffic signs to account for the increased distance required to see and react to the traffic control device (TCD). Similarly, higher-grade reflective materials should be used to increase their visibility at night. Standard traffic engineering reviews should also be carried out to ensure the TCD is properly placed and not shielded by roadside vegetation or other obstructions.

Data analysis from Section 7.3 – Traffic Control, found that Intersections where no controls were present yielded the largest percentage of victims killed or hospitalized (44.0% and 49.8%, respectively). It would appear to be a logical strategy to review policies as to why no traffic controls were present at these locations. It has been suggested that these may be intersections with private roads, but should be further investigated (see also Access Management)

Research has shown that good-quality pavement markings, which provide positive guidance to drivers, can reduce collisions by up to 35%. However, there are few standards on the retroreflectivity requirements for pavement markings, for either their initial application or when they need to be replaced. A 1992 study for Transport Canada, entitled “Driver Visibility Requirements and Reflectivity Standards,” recommended that new pavement markings have a retroreflectivity level of 0.15 cd/m²/lux and a replacement retroreflectivity level of 0.1 cd/m²/lux.

- **Modern Roundabout Intersection Design**

The use of roundabouts at intersections, instead of conventional designs, has demonstrated a 39% reduction for all collisions and 79% reduction for injury collisions. (Persaud et al), “Crash Reductions Following Installation of Roundabouts in the United States”, Insurance Institute for Highway Safety, 2001.

By design, roundabouts have fewer conflict points for vehicles, pedestrians, and cyclists. The potential for many hazardous conflicts, such as right-angle collisions and conflicting left turn head-on crashes, are eliminated with modern roundabouts.

Speeds at roundabouts are significantly lower (average of 22 mph) than other types of crossings, which allows drivers more time to react to potential conflicts. These lower speeds and speed differentials among users of roundabouts significantly reduces the severity if a collision occurs.

A TAC Joint Subcommittee is currently carrying out a project to develop a synthesis of best practices for modern roundabouts, what research gaps may exist, leading to the development of Canadian guidelines.

- **Access Management**

- Initial safety research concluded that collision rates on a roadway increased as the number of access points per kilometre. However, continued research in the area has expanded the definition of access management as the control and regulation of the spacing and design of driveways, medians, median openings, traffic signals and freeway interchanges.
- Some examples of the safety benefits of access management as presented in the 2003 Transportation Research Board's "Access Management Manual" are:
 - 55% reduction in collisions with the addition of a non-traversable median;
 - 25% to 50% reduction in collisions with the addition of a left-turn bay
 - 20% reduction in collisions with the addition of a right-turn bay
 - 42% reduction in collisions by adding visual cues or illumination at driveways.

- **Intersection Lighting**

A 1999 study sponsored by the Minnesota Department of Transportation, entitled "Safety Impacts of Street Lighting at Isolated Rural Intersections," concluded that the installation of street lighting at rural intersections offers a low-cost and very effective strategy for reducing nighttime collisions. The literature review found that the installation of intersection lighting resulted in a 25% to 50% reduction in the night-total collision ratio. A review of Minnesota data indicated lighting would be more effective than rumble strips or flashing beacons, with a benefit-cost ratio of 15:1.

A 2001 TAC report "Illumination of Isolated Rural Intersections", reviewed the warrants and safety benefits of providing intersection lighting at isolated rural intersections in Canada as opposed to continuous lighting on the road as well as at the intersection. The report's review of safety research also concluded that nighttime collisions reductions of 25 to 50 percent could be attributable to the presence of illumination.

- **Passing and Climbing Lanes**

A 1989 study for Transport Canada, entitled "Passing Manoeuvres and Passing Lanes: Design, Operational & Safety Evaluations," concluded that passing and climbing lane installations can reduce collision rates by 25% compared to untreated two-lane sections of roadway.

As referenced in TAC's 1999 Geometric Design Guide for Canadian Roads (Section 2.1.9.2), an Ontario study showed that where drivers were forced to follow slow-moving vehicles for distances of up to eight kilometres, almost 35% of the drivers made an illegal pass in a no-passing zone.

Warrants for installing passing and climbing lanes are discussed in the Geometric Design Guide.

The *Manual of Uniform Traffic Control Devices for Canada* also requires that advanced passing lane signs be posted two kilometres and one kilometre in front of passing lanes to advise drivers of the upcoming passing opportunity and thus reduce the probability of a driver making an unsafe passing manoeuvre.

4. ENFORCEMENT STRATEGIES AND PUBLIC EDUCATION

- **Rural Seat Belt Surveys / NORP / Education**

While national statistics indicate that seat belt wearing rates in urban and rural communities are very comparable (87.6% and 86.9% in 2003 and 2004, respectively, among front-seat occupants of light-duty vehicles), there are some alarming restraint use figures for rural communities. The seat belt usage rate among front-seat occupants of pickup trucks was just 79.9% during 2004 and was even lower among male occupants of pickup trucks who were less than 25 years of age (75.1%).

These survey results reinforce the findings of other safety research that indicates that the seat belt wearing rate in rural collisions is much lower than the average. Extra effort, particularly through enforcement and education programs, is required to increase this rate. A number of larger police services throughout Canada are developing strategies and programs to address lower restraint use and other high-risk road user behaviour in rural areas.

- **Child Restraints**

Given the higher speeds on rural roads, the consequences of collisions in rural areas are more severe than in urban areas, underlining the need to ensure that child restraints are being installed and used correctly.

Transport Canada's *Car Time 1-2-3-4* is a program aimed at educating the public as to the proper methods for installing and using child restraints. However, continued vigilance is required to ensure that the message is delivered and reinforced.

- **STRID**

The Strategy to Reduce Impaired Driving (STRID) has succeeded in reducing the proportion of fatal collisions in which alcohol was involved to approximately 35%. However, this is still a significant level.

As with seat belt wearing rates, studies have found that the rate of alcohol involvement tends to be higher in rural collisions than in urban collisions. Again, enforcement and education programs are required to reinforce the seriousness of these behaviours and counteract them.

- **Involve Local Communities**

The Southern Alberta Rural Seat Belt Survey, which was carried out in the late 1990s, has given an indication of the desire of communities to contribute to local road safety. The number of regional health authorities

who volunteered to collect the survey data resulted in a sample size (number of sites surveyed) larger than that used for the national seat belt survey program. It is obvious that local communities are an important resource in promoting rural road safety programs.

Several Aboriginal communities have expressed interest in accessing resources to make road travel safer in their communities. This interest has stemmed from very focused studies in designated rural regions that indicated that traffic fatality rates among Aboriginal people and the level of high-risk road user behaviour found among Aboriginal victims were considerably higher than among the general road user population. These findings suggest that partnership activities aimed at raising awareness of key road safety issues among Aboriginal people and initiatives that involve collaborative efforts between Aboriginal communities and road safety organizations would likely contribute to safer rural road travel in these communities.

5. SPEED MANAGEMENT PROGRAM

- **Uniform Application of Speed Limits**

A 1997 study for Transport Canada, "*Safety, Speed & Speed Management: A Canadian Review*," found that most jurisdictions were unsure of what methods or criteria to use for establishing speed limits or speed zoning. One of the main recommendations of the report was to develop a national speed limit program based on expert system software. The report also noted that the majority of drivers tended to select speeds they considered safe, whether above or below the posted limit, perhaps due to the inconsistency in speed zoning practices. A uniform national practice would yield uniform speed limits for similar conditions, reinforcing to drivers the message that speed limits are fair and rational.

- **High-Risk Drivers**

Research has shown that those drivers who drive at speeds in excess of the posted speed limit usually exhibit other risk-taking behaviours such as not wearing their seat belt and driving while impaired.

- **Strategic Targeted Enforcement Programs**

Due to the vastness of the rural road network, enforcement using conventional techniques has limited potential. Publicity campaigns in conjunction with targeted enforcement can increase the enforcement effects and contribute to a change in driving norms. Automated enforcement technologies that target high-collision locations should be considered.

6. ITS MEASURES

Although Intelligent Transportation Systems (ITS) are promising, the full safety potential of ITS can only be realized through research that addresses the costs of the systems, specific technical issues, the human-machine

interface and institutional and political constraints. However, implementing a number of low-cost ITS measures that will be available for deployment within the next few years could reduce the number of major collisions on rural roads.

- **Speed Advisory Systems**

Speed sensors have been developed and deployed to alert drivers that their speed is inappropriate for conditions ahead. The sensors activate flashing beacons in combination with either static or changeable message signs. One Canadian development has been the ramp advisory system, which notifies drivers if their vehicle's speed is too fast to negotiate a particular ramp radius. Currently deployed only at freeway off-ramps, these types of systems could be used at other locations, such as on rural roads that have curves with a smaller radius than required by the operating speed.

- **Road Weather Information Systems (RWIS)**

As described in Section 8.2 – Road Surface Conditions, almost half (45.4%) of drivers fatally injured in head-on crashes were killed on roads that were described as either snow/slush/ice covered (26.4%) or wet (19.0%). Similarly, more than half (56.7%) of seriously injured drivers sustained their injuries on road surfaces that were either snow/slush/ ice covered (41.1%) or wet (15.6%). This clearly identifies the role of weather conditions in collision causation.

Road Weather Information Systems (RWIS) are basically comprised of in-road and roadside sensors to monitor conditions such as pavement temperature, ambient temperature, wind speed, surface precipitation etc. These data can then be used to predict when road icing or other adverse conditions may occur. This then allows maintenance crews to prioritize what areas need to be treated and when.

A 1998 Federal Highway Administration Report "*Working Paper: Estimating the Potential Safety Benefits of Intelligent Transportation Systems*" citing a European report "*Progress in Telematics Applications for Road Transport in Europe*", European Commission DG VII/ DG XII (1996), concluded that weather monitoring systems were successful in reducing vehicle speeds by 10% and accident rates by more than 30% during inclement conditions. Furthermore, fatal and injury crashes were reduced by more than 40% during inclement conditions.

- **On-Board Vehicle Systems**

Adaptive cruise control is one of the ITS measures being explored for short-term implementation. This system combines cruise control with a headway distance warning function. When the vehicle is approaching a slower vehicle in the same lane, the system controls the vehicle speed to maintain a safe following distance.

Another promising technology currently under evaluation is the use of ultraviolet headlamps. UV headlamps have the potential to improve road safety by increasing the visibility distance of roadway pavement markings and pedestrians. This is accomplished through the introduction of phosphors in the pavement markings and through the naturally occurring phosphors in clothing that result from washing.

Other vision enhancement systems rely on supplemental cameras and infrared technologies. A night vision system using infrared has been introduced by General Motors on their higher-priced line of vehicles.

Navigation systems are currently available as an original equipment option in many new vehicles and also as after-market products. Using a Global Positioning System (GPS) for position and navigation information, these systems improve safety by eliminating a source of driver indecision, which contributes to driver error and potential collisions. Newer systems provide navigational directions to the driver using a machine voice output rather than requiring the driver to look at a map display.

An additional benefit of GPS is the ability to identify the location of the vehicle should the driver or someone else require emergency assistance. As well, the widespread introduction and use of GPS will assist in identifying the location of collisions.

While these technologies have the potential to reduce the number of collisions, they also have the potential to distract the driver or add to the driver's workload. Some drivers may pay less attention to driving because they rely on the devices to detect danger and react accordingly. The effects of these technologies on driver performance are currently under review.

7. TRAUMA MANAGEMENT SYSTEM

• Improved Collision Location Identification

Because of the relative remoteness of rural collisions, injured persons usually have to wait longer to receive medical treatment. Research findings quoted in the OECD report indicate that approximately 13% to 16% of these fatalities could be preventable if more rapid emergency treatment were available. The waiting time for emergency medical services (EMS) could be shortened if kilometer markers, exit numbers, or some other indication of location, were available to notify EMS personnel. Public education campaigns are required to ensure the general public is aware of the procedures to notify EMS. New technologies such as GPS, which are already being explored by the automobile manufacturers in systems such as Navstar and OnStar, also offer opportunities to locate collisions quickly.

• Emergency Medical Services

While the use of call boxes and cell phones can shorten the notification time, there is also the component of response and arrival times. These times can be shortened by improving the distribution and availability of ambulance

services – and, where feasible, helicopter services – and by emphasizing networks and linkages rather than stand-alone trauma centres.

- **Improved Rural Trauma Management**

Although the more settled rural areas are usually served by community or district hospitals, victims with serious injuries are usually referred to a major district hospital or larger urban hospital where staff have the necessary training or experience. A set of common guidelines and standard procedures for the care of trauma victims would save essential time by providing decision support to the rural facilities. Organized training for all rural doctors and medical personnel could assist in the early treatment of severe trauma.

9.1 Program Implementation and Evaluation

The following table suggests a format for identifying those programs already in place and those yet to be implemented.

It will be important to monitor the implementation of the programs and evaluate their benefits once they have been implemented. Road Safety Vision 2010 calls for a 40% decrease in fatalities and serious injuries on Canada's rural roads. Lead jurisdictions or support agencies should provide feedback to the agency that is overseeing the initiatives and monitoring progress towards the achievement of the safety targets. This information will provide additional evidence in support of the various activities of other jurisdictions.

Activity	Lead / Support Agencies	Description	Start Date	End Date	Expected Results	Actual Results	Comments
1. Improved Data							
Automatic collision data collection							
Expanded use of Geographic Information Systems (GIS)							
Improved linkages among safety-related databases							
2. Better Identification of Safety Problems							
Local black-spot programs							
Network Screening (3R/4R)							
National black-spot program							
In-Service Road Safety Reviews & Road Safety Audits							
3. Improved Safety of Road Design & Operations							
Continuous shoulder / centerline & transverse rumble strips							
Improved traffic control devices							

Activity	Lead / Support Agencies	Description	Start Date	End Date	Expected Results	Actual Results	Comments
Modern roundabout intersection design							
Access management							
Intersection lighting							
Passing lanes							
4. Enforcement Strategies & Public Education							
Rural seat belt surveys / Education							
Rural seat belt ad campaign							
Child restraints							
Rural impaired driving enforcement							
Involve local communities							
5. Speed Management Program							
Uniform application of speed limits							
Identification of high-risk drivers							
Targeted enforcement programs							

Activity	Lead / Support Agencies	Description	Start Date	End Date	Expected Results	Actual Results	Comments
6. ITS Measures							
Speed advisory systems							
Road Weather Information Systems (RWIS)							
On-board vehicle systems							
7. Trauma Management System							
Improved Location Identification							
Improved emergency medical services							
In-vehicle GPS locators							

10.0 Discussion

Canada's rural road casualty picture differs somewhat from the worsening situation found among other OECD member countries. The authors of the OECD report expressed concern that the level of safety improvements being realized on rural roadways in OECD member countries was falling behind the progress being achieved on urban roads and motorways. However, Canada's rural road safety situation actually improved slightly during the period examined by the authors of the OECD report.

Notwithstanding this slight improvement, rural road safety continues to be a major area of concern among road safety advocates in Canada. It is one of the principal areas targeted for improvement under Canada's national road safety plan, Road Safety Vision 2010. Under this plan, the overall national target is a 30% decrease in the number of fatalities and serious injuries by the 2008-2010 period. The sub-target for rural roads (those with posted speed limits of 80-90 km/h) is a 40% reduction during the same period. Progress will be measured against average annual fatalities and serious injuries during the 1996-2001 baseline period.

The magnitude of the rural road safety problem is evident from the casualty toll during the baseline period. On average, almost half of all road transport fatalities (47.9%) and more than one-third of all serious injuries (36.1%) occurred on rural roadways. Although Canada's rural traffic fatality toll is a concern, it is still lower, in percentage terms, than the average death toll on rural roads among OECD member countries (60% of total traffic fatalities in 1996).

Some Surprising Findings

The in-depth examination of statistics on drivers who were killed or seriously injured in the three main types of crash (single-vehicle, intersection and head-on) on Canada's rural roads confirmed a number of long-held suspicions regarding casualty trends on rural roadways. But, in some cases, the extent of the problem was surprising. Some of the more notable findings are outlined here.

In single-vehicle crashes:

- Among fatally injured drivers:
 - the high incidence of alcohol use (44.9%, minimum estimate);
 - the extremely high rate of non-use of seat belts (more than 60% for all age categories between the ages of 16 and 54, except 20-24 year olds, where the rate was 56.8%);
 - the prevalence of speed as a contributing factor (34.9%);
- the very large percentage of drivers who were killed (47.2%) or seriously injured (39.6%) on curved sections of rural roads.

In intersection collisions:

- the large percentage of fatally injured drivers who were 65 years of age or older (25.2%);

- the extremely high incidence of fatally injured older drivers (65+ years) who were driving improperly (77.3%) prior to the collision;
- the high incidence of drivers that were killed (62.1%) or seriously injured (50.3%) who committed driving infractions prior to the collision;
- the relatively high incidence of alcohol use (15.9%) and non-use of seat belts (31.8%) among fatally injured drivers;
- the high incidence of driver fatalities (44.0%) and serious injuries (49.8%) in collisions at intersections with no traffic controls present;
- the relatively high incidence of drivers being killed in intersection collisions where the roads were curved (19.6%);
- the relatively large percentage of drivers being killed (19.0%) or seriously injured (14.4%) while making a left turn at intersections.

In head-on collisions:

- the prevalence of alcohol use among dead drivers (26.1%, minimum estimate);
- the extremely high incidence of driving infractions among both fatally and seriously injured drivers (74.1% and 73.7%, respectively);
- the relatively high incidence of fatalities (33.9%) and serious injuries (31.0%) that occurred in collisions on curved sections of roads;
- the extremely small number of drivers that were killed (0.4%) or seriously injured (0.7%) in crashes where view obstructions were cited; and
- the large percentage of driver fatalities and serious injuries that occurred on snow/slush/ice covered or wet roads (45.4% and 42.0%, respectively).

The findings cited in the OECD report concerning a lack of national road safety programs specifically designed to make rural road travel safer are certainly applicable to Canada. While the use of uniform criteria for the development and implementation of safety improvements on rural roads would benefit a large segment of our society, jurisdiction over road user and roadway improvements rests with the provinces and territories.

Suggested Strategies

Road design characteristics frequently lead to driving errors and result in serious crashes on rural roads. This report therefore includes strategies that emphasize road engineering improvements.

The victim data presented in this report – specifically regarding the high incidence of speed cited as a contributing factor in single-vehicle and head-on casualty-producing crashes – strongly support the proposal for a speed management program that would result in uniform speed limits for roads with similar design characteristics throughout Canada. In fact, the frequency with which speed was reported as a contributing factor in major crashes on both

urban and rural roads led to one of the sub-targets of Road Safety Vision 2010 (a 20% decrease in fatalities and serious injuries due to speed-related crashes). The provinces, territories and municipalities have jurisdiction over maintenance and safety improvements on rural roads. Initiatives such as the implementation of a uniform national practice for developing speed limits based on common criteria and software would result in relatively low additional costs to these governments. These initiatives should be considered when road maintenance or development is being planned.

Transport Canada is currently involved in a multiyear three-phase project examining speed. The department is assessing Intelligent Speed Adaptation (ISA) technology to influence or control vehicle speeds, assessing real trip travel cost displays, and developing models to assess the safety and environmental impacts of proposed changes. Transport Canada is also involved in a national survey related to the public's attitudes towards speeding and speed choices. At the international level, Transport Canada is working with the OECD on a project examining speeding and best-practice countermeasures.

The implementation of a better trauma management system for rural roadways, leading to more rapid medical treatment, would likely prevent some fatalities. Roadside call boxes are already found on some of the more frequently travelled rural roads. The establishment of national criteria, such as a certain number of serious crashes per kilometre of roadway, could be used to identify sections of roads where call boxes would be most useful. If feasible, the realignment of stand-alone trauma centres to make them part of larger emergency medical services networks would likely lead to improved response times at rural crash sites. Better dialogue or partnership activities between road safety agencies and the health services sector would likely improve the trauma management system in rural areas.

The vast majority of single-vehicle crashes that produced fatalities and serious injuries were the result of non-collision events such as running off the road, overturning, skidding or sliding (69.6% of deaths and 75.8% of serious injuries). Most of these road users became victims as a result of one or more high-risk driving behaviours. Nevertheless, the introduction of proven safety measures to roads, such as continuous or intersection rumble strips, would likely result in fewer serious crashes. Most of the remaining single-vehicle crash victims (27.6% of those killed and 19.4% of those seriously injured) struck trees, ditches, posts, poles, rock faces or guard rails. Consideration should be given to removing some of those obstacles, where feasible, or to providing additional protection to vehicles that run off the road.

This report identifies crashes at intersections as the third most often cited crash configuration among road users killed or seriously injured on Canada's rural roads. These crashes resulted in almost 22% of fatally injured victims and nearly 28% of serious injuries. On other roads, particularly in urban settings, intersection collisions are even more dangerous. Overall they account for approximately 30% of total annual traffic fatalities and more than 40% of all serious injuries. The prevalence of this problem is why there is a quantitative sub-target for fatality and

serious injury reductions (20%) under Canada's national road safety plan, Road Safety Vision 2010.

Among victims of intersection crashes on rural roads, more than 40% of drivers were killed and more than 35% were seriously injured at intersections with stop signs. More alarming still, even more drivers were killed (44%) or seriously injured (49.8%) in crashes where no traffic controls were present. The introduction of larger stop signs with higher-grade reflective materials for increased nighttime visibility should greatly reduce the incidence of serious intersection collisions. Furthermore, the introduction of intersection lighting, whose safety benefits have been proven, at high-risk locations would also likely prove beneficial.

Approximately one-third of all drivers that were killed or seriously injured in head-on collisions on rural roads were involved in collisions on curved sections of road. The installation of passing lanes on sections of road where many serious crashes occur would greatly diminish the incidence of these types of collisions.

It has already been mentioned that roadway or roadside interventions, such as rumble strips and additional lighting, should be installed at high-risk locations. In order to identify these high-risk sections of roads, some form of black-spot program must be in place.

The details contained in this report on the three principal types of collisions occurring on rural roads were based on Canada's national traffic collision data file. However, as mentioned, data from some jurisdictions were excluded because some of the key data elements were not available. The availability of better quality, timelier and more uniform collision data would greatly benefit any type of further analysis. At present, pilot studies are being undertaken in selected provinces to test an automated data collection system that will ultimately be more efficient for all users. Another suggested strategy involving the use of data – linking rural trauma and collision data – would likely provide clear evidence of the need, or perhaps the lack of need, for realigned emergency medical services. Again, this type of activity also demonstrates the need for closer ties between the road safety and health sectors.

In-vehicle Intelligent Transportation Systems (ITS) such as adaptive cruise control, ultraviolet headlamps, infrared technologies and navigation systems are gradually being introduced into the vehicle fleet and in time may prove beneficial. The introduction of in-road speed advisory systems and intersection approach warning systems at high-risk locations would greatly benefit rural road users.

Aside from safety improvements to roads and vehicles, this report identifies a number of public education and enforcement strategies to benefit rural road users. The high incidence of non-use of seat belts and of drinking and driving in both single-vehicle and head-on collisions clearly demonstrates the need for more effective public education initiatives in these areas and, where feasible, more extensive and more focused enforcement efforts by police agencies. In addition, public education efforts that emphasize the high incidence of driver infractions before certain types of crashes (e.g. 74% of drivers killed or seriously

injured in head-on collisions) and that attempt to get the motoring public to drive more defensively might prove useful in reducing risky behaviour. A public education campaign that informs motorists that one-third of all head-on crashes that produce fatal and serious injuries on rural roads occur on curved sections of roadways may make motorists think twice about carrying out dangerous manoeuvres.

In addition to the introduction of short-, medium- and long-term strategies by the responsible road safety and road engineering agencies, one of the key ingredients required for a successful rural road strategy is the active interest and involvement of rural communities or municipalities. Local communities are best positioned to identify their major road safety problems. They would also be able to identify the local organizations that might work collaboratively to address the major problems. A successful example of this type of activity took place in southern Alberta in the late 1990s. The efforts of the Royal Canadian Mounted Police, the health community and other municipal organizations as well as many volunteers contributed to safer road use in the regions involved in the Southern Alberta Demonstration Project.

11.0 Recommendations

The initiatives outlined in the strategies section and elaborated upon in the discussion section of this report should be prioritized into short-, medium- and long-term activities. The prioritization should incorporate realistic assessments of the likelihood of implementation by most jurisdictions, based in large part on the estimated costs and resulting benefits of these activities.

A nationally representative task force that could raise awareness of key road safety problems unique to – or at least more prevalent on – rural roads would benefit all jurisdictions. The task force, which would be created under the auspices of CCMTA and comprise key public and private sector stakeholders from the road user, highway planning and design and operations and maintenance domains, would develop strategies and initiatives on a national scale to address these problems. Similar groups exist to address most of the other major road safety issues in Canada. The benefits of the initiatives that have been developed and implemented by long-standing nationally representative groups such as the CCMTA'S National Occupant Restraint Program (NORP) and CCMTA'S Strategy to Reduce Impaired Driving (STRID) task forces have already been proven.

Clearly, reducing the death and injury toll on our rural roads is critical to safer road travel in Canada and to the achievement of the quantitative targets of Road Safety Vision 2010.

Appendix

Table SV1

**Percent of Drivers Fatally Injured in Single-Vehicle Crashes on Rural Roads
Who Had Been Drinking/Were Impaired by Age Categories
Selected Jurisdictions - 1995-1999 Average**

Driver Age	Injury Severity	
	Killed (%)	Seriously Injured (%)
16-19	35.8	22.2
20-24	56.2	35.5
25-34	60.0	38.0
35-44	51.8	38.4
45-54	40.3	22.1
55-64	27.1	16.9
65+	15.9	7.3
All Ages	44.9	29.7

Note: The above figures are minimum estimates that were derived from subjective observations by police officers at crash sites.

Table SV2

**Percent of Drivers Killed/Seriously Injured in Single-Vehicle
Crashes on Rural Roads Who Were Driving Too Fast/Speeding
Selected Jurisdictions - 1995-1999**

Driver Age	Injury Severity	
	Killed (%)	Seriously Injured (%)
16-19	49.9	31.0
20-24	46.4	31.4
25-34	42.7	28.7
35-44	30.7	22.8
45-54	32.4	18.9
55-64	17.4	13.5
65+	16.4	12.4
All Ages	34.9	25.1

Table SV3
Percent of Drivers Killed/Seriously Injured in Single-Vehicle
Crashes on Rural Roads According to Driver Gender
Selected Jurisdictions - 1995-1999

Driver Age	Injury Severity			
	Killed		Seriously Injured	
	Male	Female	Male	Female
0-15	0.3	0.0	0.6	0.2
16-19	7.7	1.7	8.2	3.4
20-24	15.3	1.9	12.4	3.1
25-34	19.6	2.5	20.4	5.9
35-44	14.9	3.5	13.8	5.4
45-54	10.9	1.8	7.8	4.2
55-64	6.5	1.4	3.6	2.0
NL 65	9.5	2.5	5.0	3.3
All Ages	84.8	15.2	72.4	27.6

Table SV4
Percent of Drivers Killed/Seriously Injured in Single-Vehicle Crashes on Rural Roads
According to Restraint Use, Ejection Status and Alcohol Use
Selected Jurisdictions - 1995-1999

	% Unbelted	% Unbelted & Ejected	% Unbelted & Drinking/Impaired
16-19	63.6	38.2	30.9
20-24	56.8	37.8	34.2
25-34	72.7	50.8	46.9
35-44	61.0	39.8	35.4
45-54	62.1	42.4	43.9
55-64	36.4	22.7	15.9
65+	30.3	10.5	9.2
16-19	25.0	14.4	10.6
20-24	28.9	14.7	15.6
25-34	30.5	14.1	17.8
35-44	25.4	10.4	16.4
45-54	17.8	6.6	8.5
55-64	18.8	5.8	6.5
65+	12.3	2.5	2.5

Table SV5A

**Percent of Drivers Killed/Seriously Injured in Single-Vehicle Crashes
on Rural Roads by Type of Vehicle Occupied
Selected Jurisdictions - 1995-1999**

Injury Severity	Vehicle Type		
	Car	Light Truck/Van	Commercial Vehicle
Killed	66.4	29.6	4.0
Seriously Injured	68.1	28	3.9

Table SV5B

**Percent of Unbelted Drivers Killed/Seriously Injured in Single-Vehicle
Crashes on Rural Roads by Type of Vehicle Occupied
Selected Jurisdictions - 1995-1999**

Injury Severity	Vehicle Type		
	Car	Light Truck/Van	Commercial Vehicle
Killed	49.8	69.6	70.6
Seriously Injured	23.0	26.7	23.8

Table SV6

**Percent of Drivers Killed/Seriously Injured in Single-Vehicle Crashes
on Rural Roads According to Vehicle Event
Selected Jurisdictions - 1995-1999**

Injury Severity	Vehicle Event			
	Hit Moving Object	Hit Obstacle	Non-Collision Event	Total
Killed	2.8	27.6	69.6	100.0
Seriously Injured	4.9	19.4	75.8	100.0

Table SV7A

**Percent of Drivers Killed/Seriously Injured in Single-Vehicle Crashes
on Rural Roads Who Were Belted According to Light Conditions
Selected Jurisdictions - 1995-1999**

Injury Severity	Light Conditions			
	Dark/Artificial Road Lighting	Dawn/Dusk	Day	Total
Killed	46.2	5.2	48.6	100.0
Seriously Injured	42.0	5.1	52.9	100.0

Table SV7B
Percent of Drivers Killed/Seriously Injured in Single-Vehicle Crashes
on Rural Roads Who Were Unbelted According to Light Conditions
Selected Jurisdictions - 1995-1999

Injury Severity	Light Conditions			
	Dark/Artificial Road Lighting	Dawn/Dusk	Day	Total
Killed	66.3	5.3	28.4	100.0
Seriously Injured	58.4	8.0	33.6	100.0

Table SV7C
Percent of Drivers Killed/Seriously Injured in Single-Vehicle Crashes
on Rural Roads Who Were Unbelted & Had Been Drinking/Were Impaired
According to Light Conditions
Selected Jurisdictions - 1995-1999

Injury Severity	Light Conditions			
	Dark/Artificial Road Lighting	Dawn/Dusk	Day	Total
Killed	78.0	5.1	16.9	100.0
Seriously Injured	74.7	5.4	19.9	100.0

Table SV8
Percent of Drivers Killed/Seriously Injured in Single-Vehicle Crashes
on Rural Roads According to Road Surface Condition
Selected Jurisdictions - 1995-1999

Injury Severity	Road Surface Condition				
	Dry	Snow/Slush /Ice	Wet	Other Conditions	Total
Killed	75.2	9.3	14.2	1.3	100.0
Seriously Injured	62.5	13.9	23.0	0.6	100.0

Table SV9

**Percent of Drivers Killed/Seriously Injured in Single-Vehicle Crashes
on Rural Roads According to Road Configuration
Selected Jurisdictions - 1995-1999**

Injury Severity	Road Configuration			
	Intersection	Non-Intersection	Railway Crossing/ Tunnel/Other	Total
Killed	13.1	77.2	9.7	100.0
Seriously Injured	19.0	76.9	4.1	100.0

Table SV10

**Percent of Drivers Killed/Seriously Injured in Single-Vehicle Crashes
on Rural Roads According to Road Alignment
Selected Jurisdictions - 1995-1999**

Injury Severity	Road Alignment		
	Other Alignments	Curved Level/Grade	Total
Killed	52.8	47.2	100.0
Seriously Injured	60.4	39.6	100.0

Table SV11

**Percent of Drivers Killed/Seriously Injured in Single-Vehicle Crashes
on Rural Roads According to Traffic Control
Selected Jurisdictions - 1995-1999**

Injury Severity	Traffic Controls					
	No Traffic Controls	Other Conditions	Rail Crossing	Traffic Signals	Traffic Signs	Total
Killed	94.1	0.9	0.3	0.4	4.3	100.0
Seriously Injured	92.2	0.5	0.0	1.1	6.2	100.0

Table IC1
Percent of Drivers Killed/Seriously Injured in Intersection Crashes
On Rural Roads According to Driver Age Group
Selected Jurisdictions 1995-1999

Injury Severity	Driver Age Group									
	LT 16	16-19	20-24	25-34	35-44	45-54	55-64	65+	Unknown	Total
Killed	0.2	8.0	11.1	16.4	14.4	13.0	11.2	25.5	0.2	100.0
Seriously Injured	0.5	8.1	11.2	21.7	20.4	15.1	8.6	13.9	0.5	100.0

Table IC2
Percent of Drivers Killed/Seriously Injured in Intersection Crashes
On Rural Roads Who Had Been Drinking/Were Impaired According to Driver Age Group
Selected Jurisdictions 1995-1999

Injury Severity	Driver Age Group									
	LT 16	16-19	20-24	25-34	35-44	45-54	55-64	65+	Unknown	Total
Killed	0.0	13.3	25.8	27.2	25.9	16.4	7.9	2.8	0.0	15.9
Seriously Injured	0.7	11.6	13.9	16.7	13.1	9.0	7.2	1.8	16.7	11.2

Table IC3A
Percent of Drivers Killed in Intersection Crashes
On Rural Roads According to Driver Action and Age Group
Selected Jurisdictions 1995-1999

Driver Age	Driver Action					
	Driving Properly	Driving Too Fast/Speeding	Fail To Yield ROW	Disobey Traffic Control	Lost Control	Other Infractions
16-19	33.2	9.0	26.5	19.9	2.5	9.0
20-24	34.2	28.1	7.6	15.9	7.8	6.3
25-34	41.1	15.4	10.6	16.7	7.8	8.4
35-44	50.8	13.5	8.3	13.2	6.2	8.0
45-54	52.7	5.7	22.3	13.2	1.5	4.7
55-64	41.7	3.1	23.5	19.4	6.3	6.2
65+	22.3	1.9	34.2	22.9	4.2	14.5
Total	37.9	9.6	21.1	17.6	5.4	8.4

Table IC3B

**Percent of Drivers Seriously Injured in Intersection Crashes
On Rural Roads According to Driver Action and Age Group
Selected Jurisdictions 1995-1999**

Driver Age	Driver Action					
	Driving Properly	Driving Too Fast/Speeding	Fail To Yield ROW	Disobey Traffic Control	Lost Control	Other Infractions
16-19	36.4	10.2	16.5	16.2	8.1	12.6
20-24	45.5	11.1	12.4	10.3	11.2	9.5
25-34	52.1	9.5	9.1	10.5	8.4	10.5
35-44	55.5	6.1	13.6	11.6	6.1	7.1
45-54	60.2	7.8	11.9	9.2	4.6	6.2
55-64	50.0	1.6	18.0	12.6	7.1	10.8
65+	37.2	2.9	28.8	12.6	4.3	14.2
Total	49.7	7.1	15.2	11.5	6.8	9.7

Table IC4A

**Percent of Drivers Killed in Intersection Crashes
On Rural Roads According to Driver Age Group & Gender
Selected Jurisdictions 1995-1999**

Gender	Driver Age Group									Total
	LT 16	16-19	20-24	25-34	35-44	45-54	55-64	65+	Unknown	
Male	0.2	5.5	9.1	12.8	10.0	9.6	7.7	18.5	0.2	73.6
Female	0.0	2.5	2.0	3.6	4.4	3.4	3.5	7.0	0.0	26.4

Table IC4B

**Percent of Drivers Seriously Injured in Intersection Crashes
On Rural Roads According to Driver Age Group & Gender
Selected Jurisdictions 1995-1999**

Gender	Driver Age Group									Total
	LT 16	16-19	20-24	25-34	35-44	45-54	55-64	65+	Unknown	
Male	0.4	5.8	8.3	13.9	13.0	9.9	5.9	8.3	0.3	65.8
Female	0.1	2.3	3.0	7.8	7.4	5.2	2.7	5.6	0.1	34.2

Table IC5

**Percent of Drivers Killed/Seriously Injured in Intersection Crashes on Rural Roads
According to Restraint Use, Ejection Status and Alcohol Use
Selected Jurisdictions 1995-1999**

Killed	% Unbelted	% Unbelted & Ejected	% Unbelted & Drinking/Impaired
16-19	28.6	8.6	11.4
20-24	40.4	25.5	25.5
25-34	50.8	21.5	23.1
35-44	38.3	10.0	16.7
45-54	33.3	10.5	14.1
55-64	29.6	5.6	1.9
65+	16.8	5.6	0.8
Seriously Injured			
16-19	17.0	5.9	6.5
20-24	24.0	6.7	5.3
25-34	19.1	5.1	6.5
35-44	14.1	2.3	5.5
45-54	12.6	3.3	2.0
55-64	10.5	5.0	1.1
65+	7.1	0.7	3.7

Table IC6

**Percent of Drivers Killed/Seriously Injured in Intersection Crashes on Rural Roads
According to Vehicle Manoeuvre - Selected Jurisdictions 1995-1999**

Injury Severity	Vehicle Manoeuvre					Total
	Going Straight	Turning Left	Turning Right	Overtaking	All Others	
Killed	70.0	19.0	0.4	2.7	7.8	100.0
Seriously Injured	73.3	14.4	1.2	2.5	8.5	100.0

Table IC7

**Percent of Drivers Killed/Seriously Injured in Intersection Crashes on Rural Roads
According to Time of Day - Selected Jurisdictions 1995-1999**

Injury Severity	Time of Day				Total
	Daytime	Evening	Night	Rush Hour	
Killed	41.4	16.2	21.4	21.0	100.0
Seriously Injured	39.6	14.8	18.1	27.5	100.0

Table IC8

**Percent of Drivers Killed/Seriously Injured in Intersection Crashes on Rural Roads
According to Road Alignment - Selected Jurisdictions 1995-1999**

Injury Severity	Road Alignment			
	Straight	Curved	Hill	Total
Killed	80.0	19.4	0.6	100.0
Seriously Injured	82.7	16.9	0.4	100.0

Table IC9

**Percent of Drivers Killed/Seriously Injured in Intersection Crashes on Rural Roads
According to Traffic Controls - Selected Jurisdictions - 1995-1999**

Injury Severity	Traffic Controls				Total
	No Control Present	Stop Sign	Traffic Signals	Other / Unknown	
Killed	44.0	41.0	9.8	5.1	100.0
Seriously Injured	49.8	35.4	9.4	5.4	100.0

Table IC10

**Percent of Drivers Killed/Seriously Injured in Intersection Crashes on Rural Roads
According to Environmental Conditions - Selected Jurisdictions 1995-1999**

Injury Severity	Environmental Conditions					Total
	Road Construction	Slippery / Snow	View Obstructed	Other	Non-Environmental	
Killed	0.5	2.1	1.6	0.8	95.1	100.0
Seriously Injured	1.4	1.4	0.9	0.2	96.1	100.0

Table IC11

**Percent of Drivers Killed/Seriously Injured in Intersection Crashes on Rural Roads
According to Road Surface Condition - Selected Jurisdictions 1995-1999**

Injury Severity	Road Surface Condition			Total
	Dry	Snow/Slush/Ice	Wet	
Killed	72.9	8.9	18.2	100.0
Seriously Injured	70.2	10.9	18.9	100.0

Table HO1

Percent of Drivers Killed/Seriously Injured in Head-On Crashes on Rural Roads
According to Driver Age Group - Selected Jurisdictions 1995-1999

Injury Severity	Driver Age Group							Total
	Under 20	20 to 24	25 to 34	35 to 44	45 to 54	55 to 64	65 +	
Killed	8.1	13.2	20.9	18.8	15.1	10.4	13.4	100.0
Seriously Injured	8.2	12.8	23.6	23.4	15.8	8.1	8.2	100.0

Table HO2

Percent of Drivers Killed/Seriously Injured in Head-On Collisions on Rural Roads
According to Driver Gender and Age Category - Selected Jurisdictions 1995-1999

Injury Severity	Driver Age Category							Total
	Under 20	20 to 24	25 to 34	35 to 44	45 to 54	55 to 64	65 +	
Killed								
Female	8.0	15.6	19.3	19.3	15.6	11.0	11.2	31.0
Male	8.1	12.2	21.6	18.7	14.9	10.1	14.4	69.0
Total	8.1	13.2	20.9	18.8	15.1	10.4	13.4	100.0
Seriously Injured								
Female	7.3	12.1	25.7	25.8	14.9	6.6	7.6	36.2
Male	8.6	13.2	22.4	22.0	16.3	8.9	8.5	63.8
Total	8.2	12.8	23.6	23.4	15.8	8.1	8.2	100.0

Table HO3

Percent of Road Users Killed/Seriously Injured in Head-On Crashes on Rural Roads
According to Road User Class - Selected Jurisdictions 1995-1999

Injury Severity	Road User Class					Total
	Bicyclist	M.V. Occupant	Motorcycle Rider	Pedestrian	Other / Unknown	
Killed	0.2	95.3	2.9	0.7	0.8	100.0
Seriously Injured	0.2	96.4	1.5	0.1	1.7	100.0

Table HO4

Percent of Drivers Killed/Seriously Injured in Head-On Crashes on Rural Roads
According to Seat Belt Use & Ejection Status - Selected Jurisdictions 1995-1999

Injury Severity	Unrestrained		Restrained		Total
	Ejected	Not Ejected	Ejected	Not Ejected	
Killed	5.3	17.9	5.6	71.2	100.0
Seriously Injured	2.2	8.2	1.5	88.0	100.0

Table HO5
Percent of Drivers Killed/Seriously Injured in Head-On Crashes
on Rural Roads According to Driver Condition
Selected Jurisdictions 1995-1999

Injury Severity	Driver Condition			
	Had Been Drinking / Impaired	Inattentive /Tired	Other/Non-Driver Factors	Total
Killed	26.1	15.1	58.8	100.0
Seriously Injured	18.3	14.5	67.2	100.0

Table HO6
Percent of Drivers Killed/Seriously Injured in Head-On Crashes on Rural Roads
According to Driver Action - Selected Jurisdictions 1995-1999

Injury Severity	Driver Action				
	Driving Too Fast / Speeding	Lost Control	Other Infractions /Errors	Non-Driver Related	Total
Killed	21.3	21.7	31.1	25.9	100.0
Seriously Injured	23.0	28.9	21.8	26.3	100.0

Table HO7
Percent of Drivers Killed/Seriously Injured in Head-On Crashes on Rural Roads
According to Vehicle Manoeuvre - Selected Jurisdictions 1995-1999

Injury Severity	Vehicle Manoeuvre					
	Going Straight	Turning Left	Turning Right	Overtaking	All Others	Total
Killed	83.4	0.5	0.2	5.5	10.4	100.0
Seriously Injured	89.0	0.6	0.1	4.6	5.7	100.0

Table HO8
Percent of Drivers Killed/Seriously Injured in Head-On Crashes on Rural Roads
According to Time of Day - Selected Jurisdictions 1995-1999

Injury Severity	Time of Day				
	Daytime	Evening	Night	Rush Hour	Total
Killed	35.4	13.3	23.0	28.3	100.0
Seriously Injured	34.9	16.7	17.5	30.9	100.0

Table HO9

Percent of Drivers Killed/Seriously Injured in Head-On Collisions on Rural Roads
According to Road Alignment - Selected Jurisdictions 1995-1999

Injury Severity	Road Alignment			
	Straight	Curved	Hill	Total
Killed	65.4	33.9	0.7	100.0
Seriously Injured	68.8	31.0	0.2	100.0

Table HO10

Percent of Drivers Killed/Seriously Injured in Head-On Collisions on Rural Roads
According to Environmental Conditions - Selected Jurisdictions 1995-1999

Injury Severity	Environmental Conditions					Total
	Road Construction	Slippery / Snow	View Obstructed	Other	Non-Environmental	
Killed	1.6	3.4	0.4	1.0	93.6	100.0
Seriously Injured	1.0	7.5	0.7	0.4	90.4	100.0

Table HO11

Percent of Drivers Killed/Seriously Injured in Head-On Collisions on Rural Roads
According to Traffic Controls - Selected Jurisdictions 1995-1999

Injury Severity	Traffic Controls				Total
	No Control Present	Stop Sign	Traffic Signals	Other / Unknown	
Killed	95.9	0.8	0.2	3.1	100.0
Seriously Injured	95.8	1.0	0.3	2.9	100.0

Table HO12

Percent of Drivers Killed/Seriously Injured in Head-On Collisions on Rural Roads
According to Road Surface Condition - Selected Jurisdictions 1995-1999

Injury Severity	Road Surface Condition			Total
	Dry	Snow/Slush/Ice	Wet	
Killed	54.6	26.4	19.0	100.0
Seriously Injured	43.3	41.1	15.6	100.0

Table HO13

**Percent of Drivers Killed/Seriously Injured in Head-On Collisions on Rural Roads
According to Weather Condition - Selected Jurisdictions 1995-1999**

Injury Severity	Weather Condition							Total
	Dust, Smoke	Fog, Smog, Mist	Raining	Sleet, Hail	Snowing	Strong Winds	Clear	
Killed	0.1	1.8	9.2	1.1	15.5	0.8	71.6	100.0
Seriously Injured	0.1	2.6	8.8	1.6	24.5	1.4	61.0	100.0

Table HO14

**Percent of Drivers Killed/Seriously Injured in Head-On Collisions on Rural Roads
According to Road Configuration - Selected Jurisdictions 1995-1999**

Injury Severity	Road Configuration						Total
	Bridge, Overpass	Intersect: >1 Rd	Intersect: Priv Rd	Intersect: Tr Cntl	Non- intersection	RR Level Crossing	
Killed	0.7	6.8	1.5	1.5	89.3	0.2	100.0
Seriously Injured	0.7	10.1	2.0	1.7	85.3	0.2	100.0