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RISK MANAGEMENT: A NEW APPROACH TO IMPROVING SAFETY

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1. ABSTRACT

This national report is based on a larger study being undertaken through the Civil Engineering Graduate Program at Carleton University in Ottawa, Ontario Canada. This report focuses on fatal, injury, and property damage collision data collected from Transport Canada's Traffic Accident Information Database for the years of 1984 to 2003. A 20-year collision analysis was compared with a 5-year analysis from 1999 to 2003 in order to compare long-term trends with more recent ones and to identify specific collision characteristics that require attention. Based on the results of the two analyses, a number of countermeasures were recommended for consideration to improve road safety on Canadian roads.

2. INTRODUCTION

About 2,500 fatal collisions and about 150,000 injury collisions occur on Canadian roads each year. It is important to understand the characteristics of these collisions in order to determine the factors contributing to their occurrence and measures that may be employed to prevent them or reduce their severity. The collection of accurate collision data is necessary to achieve these objectives but is a constant challenge in our country. Each province uses their own unique collision report form with different variables and criteria and it is the responsibility of police officers to analyze the collisions and assess its contributing factors based on their own knowledge and judgment of the incident.

In order to get a national perspective on the overall collision situation, Transport Canada merges collision data from all provinces and territories into their own collision database where it may be analyzed. This enables the federal government to cater road safety projects and programs to emerging problems and be proactive by studying collision trends over time.

Canada's Road Safety Vision 2010 has a national goal of making Canadian roads the safest in the world with a target of decreasing the number of road users killed or seriously injured by 30 percent during the 2008 to 2010 period compared with the 1996 to 2001 period.

In assisting Canada to achieve this goal, 20 years of Canadian collision data from 1984 to 2003 was extracted from Transport Canada's Traffic Accident Information Database (TRAID). The data was analyzed at a 20-year (1984-2003) level and compared with a 5-year (1999-2003) level, observed trends were documented, and recommendations were made on ways to improve the road safety condition in Canada. This national report is based on research currently being conducted under the Civil Engineering Graduate Program at Carleton University in Ottawa, Ontario, Canada.

3. METHODOLOGY

After a preliminary scan of the overall collision data available from each province and territory, it was decided to eliminate the three territories, Nunavut, the Northwest Territories, and the Yukon from the scope of the study. Compared to the provinces, collision occurrences in the territories were rare and therefore there was limited information available. Only the 10 provinces were included in the study: Nova Scotia, New Brunswick, Newfoundland, Prince Edward Island, Quebec, Ontario, Manitoba, Saskatchewan, Alberta, and British Columbia. It

should be noted that Manitoba's data for 1989 were missing from TRAID and was therefore excluded from the analysis. Also, where a data element was poorly represented for a specific province, it is noted in the Main Findings of Section 4 of the report.

A list of 17 data elements was selected for analysis from TRAID. The data elements chosen were based on the availability of data from all provinces and focused mainly on road and environmental factors associated with the collisions. However, some human factor and person level characteristic data elements were also included in order to add diversity to the study and better understand Canada's overall road safety situation. Collisions that contained unknown values for data elements were excluded from the analysis.

Data elements in TRAID are divided into three categories, Collision Data, Vehicle Data, and Persons Data. Data elements that were used in the analysis were taken from each of the three categories as shown below. A list of the values included in each data element may be found in Section 7 Appendix A.

3.1. Data Elements – Collision Data

Collision Severity
Collision Configuration
Road Category
Road Classification
Road Alignment
Road Configuration
Road Surface Condition
Collision Hour
Day of Week
Month of Collision
Light Condition
Traffic Control
Speed Limit

3.2. Data Elements – Vehicle Data

Driver Condition Contributing Factor
Driver Action Contributing Factor

3.3. Data Elements – Person Data

Age
Gender

Twenty years of fatal, injury, and property damage national collision data from 1984 to 2003 was collected for each of the above data elements. Data from 2003 was the most recent data available at the start of the analysis. The data was retrieved from TRAID using the computer program Brio Intelligence Explorer by conducting data queries. The data was then transferred to Excel spreadsheets where pivot tables and pivot charts were developed for each data element in order to analyze and compare the data more efficiently.

The data elements were analyzed at a 20-year (1984-2003) level and at a 5-year level (1999-2003). Significant findings of the two analyses were compared and summarized by data element in order to compare long-term and more recent collision trends. Based on this information, recommendations were made on road safety countermeasures that may be implemented in order to address fatal, injury and property damage collisions in Canada.

4. RESULTS OF 20-YEAR AND 5-YEAR LEVEL COLLISION ANALYSES AND COUNTERMEASURE RECOMMENDATIONS

4.1. Collision Severity

4.1.1. Main Findings

In the 20-Year Analysis, fatal collisions have gradually been decreasing. There were 3,559 fatal collisions in 1984 and 2,468 in 2003 resulting in a 31 percent decrease. Overall, fatal collisions made up 0.45 percent of all collisions. There was also a slight decrease in injury collisions. There were 164,866 injury collisions in 1984 and 154,062 in 2003 resulting in a 7 percent decrease. Overall, injury collisions made up 24 percent of all collisions. Property damage collisions on the other hand have remained quite constant. There were 509,064 property damage collisions in 1984 and 501,852 in 2003 resulting in a one percent decrease. Overall, property damage collisions made up 75 percent of all collisions.

By comparison, in the 5-Year Analysis, fatal collisions have decreased. There were 2,612 fatal collisions in 1999 and 2,468 in 2003 resulting in a 6 percent decrease. Overall, fatal collisions made up 0.40 percent of all collisions. Injury collisions have actually increased. There were 150,673 injury collisions in 1999 and 154,062 in 2003 resulting in an increase of about 2 percent. Overall, injury collisions made up 25 percent of all collisions. Property damage collisions have also increased. There were 441,598 property damage collisions in 1999 and 501,852 in 2003 resulting in an increase of 12 percent. Overall, property damage collisions made up 75 percent of all collisions.

4.1.2. Discussion and Recommendations

Fatal collisions have shown a decrease in both the 20-Year Analysis and the 5-Year Analysis, which is promising. However, there were still almost 2,500 fatal collisions in 2003 and it is recommended that addressing these collisions should remain a priority for Canada.

Although injury collisions showed a decrease in the 20-year Analysis, they have increased between 1999 and 2003, which could be an indication that they are on the rise. These collisions should be monitored closely and addressed according to the characteristics of the collisions.

While the dollar threshold for reporting property damage collisions has increased over the years, one would expect the number of reported collisions to decrease if all other factors were equal. However, the cost of collision repairs and the number of registered vehicles have also increased, resulting in the number of property damage collisions remaining fairly constant.
However, these collisions should not be ignored and should be considered in all road safety programs implemented by jurisdiction.

4.2. Collision Configuration

4.2.1. Main Findings

In the 20-Year Analysis, 29 percent of fatal collisions occurred when a single vehicle hit an object or person, 21 percent occurred when two motor vehicles were involved in head-on collisions, and 19 percent were run off the road collisions (running off left or right shoulders). For injury collisions, 24 percent were rear-end collisions, and 18 percent occurred when a single vehicle hit an object or person. For property damage collisions, 22 percent occurred when a single vehicle hit an object or person, and 20 percent were rear-end collisions.

By comparison, in the 5-Year Analysis, 25 percent of fatal collisions occurred when a single vehicle hit an object or person, 21 percent were run off the road collisions, and 20 percent occurred when two motor vehicles were involved in head-on collisions. For injury collisions 27 percent were rear-end collisions, and 17 percent occurred when a single vehicle hit an object or person. For property damage collisions, 28 percent occurred when a single vehicle hit an object or person, and 22 percent were rear-end collisions.

4.2.2. Discussion and Recommendations

The 20-Year and 5-Year Analyses produced similar trends for this data element. It appears that head-on and run off the road collisions usually result in a fatality, motor vehicle hit object or person collisions were common as fatal, injury, and property damage collisions, and rear-end collisions commonly resulted in injury or property damage collisions.

Head-on collisions usually occur when one motor vehicle passes over the centreline of the roadway and is driving in the opposing lane of traffic. This move could be unintentional because of driver inattention or distraction or it could be intentional where a driver is overtaking another vehicle. If the move were unintentional, centreline rumble strips would provide an audible and physical warning that the driver has crossed the centreline. In this case the driver may correct the manoeuvre, decreasing the risk of being involved in a collision. Also, reflectorized pavement markings and adequate roadway lighting would provide positive guidance to the driver and roadway medians would provide a safety barrier between opposing traffic. If the manoeuvre were intentional, the road may have been designed with insufficient passing opportunities resulting in drivers taking risks and passing in undesignated passing zones. The addition of more passing lanes or climbing lanes, paved shoulders and improved shoulder width with sufficient recovery areas along the roadside would assist in this situation.

Run off road collisions could occur for a number of reasons. Possible contributing factors include a slippery road surface, a curve designed too sharp, a driver losing control of his/her vehicle because of driving too fast for conditions, or driver inattention. Safety countermeasures that would decrease the occurrence and/or the severity of these collisions would be the installation of centreline and shoulder rumble strips, a forgiving roadside with adequate recovery areas, roadway medians, and guardrails.

Motor vehicle hit object or person collisions, may refer to circumstances where a vehicle hit a pedestrian, bicyclist, parked car, foreign object on the road, or an animal. The level of severity of these collisions increases with an increase in the vehicle's speed and the size, shape, weight, and type of the object being hit. To address pedestrian safety, educational campaigns

may be implemented to inform pedestrians of precautions they could take in order to protect themselves as road users. For example, wearing reflective clothing when walking or biking on the road at night should be considered mandatory. For motor vehicle drivers, methods and techniques taught in driver education schools such as glancing further down the road to be aware of potential upcoming conflict situations and slowing down when driving through curves or ascending the top of a graded section of the road should be stressed in road safety awareness campaigns. Parking restrictions may also be employed.

Rear-end collisions are often the result of drivers following the vehicle ahead too closely, driver inattention, drivers driving too fast for conditions or because of slippery road surface conditions. Educational campaigns should be targeted to aggressive drivers who tend to drive recklessly, speed and tailgate other vehicles on the roadway. More police enforcement and stricter penalties would also help in this situation. Slippery road surfaces may be addressed by providing high friction pavement and/or salting the roadway in a timely fashion on icy/snowy roads. The installation of advanced signs warning of signal or stop controls ahead and two-way left turn lanes or left-turn or right-turn channelization at intersections could also help reduce these types of collisions.

4.3. Road Category

4.3.1. Main Findings

Quebec does not collect this variable and therefore was excluded from the analysis.

In the 20-Year Analysis, 81 percent of fatal collisions, 75 percent of injury collisions, and 78 percent of property damage collisions occurred on undivided roads. However 15 percent of property damage collisions occurred on divided roads.

By comparison, in the 5-Year Analysis, 80 percent of fatal collisions, 75 percent of injury collisions, and 75 percent of property damage collisions occurred on undivided roads. However, 24 percent of property damage collisions occurred on divided roads.

4.3.2. Discussion and Recommendations

It is apparent from both the 20-Year and 5-Year Analyses that undivided roads cause a vulnerable situation for drivers. This is especially the case on two-lane undivided highways where the speed limit could be 80 or 90 km/h and opposing traffic has no protection between them. This condition becomes dangerous mixed with factors such as driver inattention, driver fatigue, or if a driver is forced to avoid an object on the roadway by swerving out of the way. Also, without passing lanes, drivers are forced to use the opposing lane of traffic to overtake another vehicle. Countermeasures that could decrease the chance of collisions would be a median between opposing lanes of traffic, positive guidance through road design, passing or climbing lanes, wider and/or paved shoulders and recovery areas on the roadside, adequate speed warning signs on approaches to curves or hills, widened roadway lane widths, shoulder and centreline rumble strips, flattened horizontal and vertical curves, highly reflective pavement markings and signs, and improved roadway lighting. A more costly option would be to realign the roadway and replace the two-lane undivided road with a four-lane divided road.

The increase in collisions occurring on divided highways between the 20-Year and 5-Year Analyses may be attributed to the increase in the number of divided highways in Canada throughout the years.

4.4. Road Classification

4.4.1. Main Findings

Quebec does not collect property damage collisions for this data element; therefore these collisions were not able to be included in the analysis. However, fatal and injury collisions for Quebec were included.

In the 20-Year Analysis, 65 percent of fatal collisions occurred on rural roads whereas 35 percent occurred on urban roads, 71 percent of injury collisions occurred on urban roads whereas 29 percent occurred on rural roads, and 75 percent of property damage collisions occurred on urban roads whereas 25 percent occurred on rural roads.

By comparison, in the 5-Year Analysis, 68 percent of fatal collisions occurred on rural roads whereas 32 percent occurred on urban roads, 72 percent of injury collisions occurred on urban roads whereas 28 percent occurred on rural roads, and 71 percent of property damage collisions occurred on urban roads whereas 29 percent occurred on rural roads.

4.4.2. Discussion and Recommendations

The results of both the 20-Year and 5-Year Analysis show that fatal collisions are more common on rural roads than on urban roads and that injury and property damage collisions more often occur on urban roads then on rural roads.

Undivided rural roads, which are quite common across the country, are a cause for concern. Please refer to the Road Category data element for specific countermeasures recommended for undivided roads. Speed also plays a significant factor in rural road collisions. Higher driving speeds associated with rural roads increases the severity level of a collision and more often results in a driver losing control of his/her vehicle. Additional countermeasures that may be considered to decrease the severity of collisions on rural roads include improving the side slope of the road to reduce loss-of-control of vehicles leaving the road surface and providing roadside barriers, crash cushions to fixed roadside objects, breakaway devices for poles and signs, energy-absorbing barrier end treatments, and access management.

Urban roads represent the majority of the injury and property damage collisions. Vehicle and pedestrian exposure is quite high compared to rural roads especially during peak hour periods. Urban intersections also pose a vulnerable situation for drivers and pedestrians because of their high number of conflict points. To address vehicle-pedestrian collisions, efforts should be made to provide adequate provisions for pedestrians such as sidewalks, pedestrian refuge areas for crossing the roadway, marked pedestrian crosswalks, pedestrian traffic signals, and pedestrian grade separation. For additional countermeasures for urban areas, please refer to the Collision Configuration data element describing vehicle hit object or person collisions and rear-end collisions and the Road Configuration data elements describing intersection collisions.

4.5. Road Alignment

4.5.1. Main Findings

Quebec does not collect property damage collisions for this data element; therefore these collisions were not able to be included in the analysis. However, fatal and injury collisions for Quebec were included.

It is important to note that in order to determine the percentages of collisions that occurred on curves, two data values were taken into consideration (curved and level and curved and gradient). Similarly, in order to determine the percentages of collisions that occurred on gradients, two data values were used (straight and gradient and curved and gradient). This resulted in an overlap in the data value, curved and gradient, for the percentage calculations.

In the 20-Year Analysis, 57 percent of fatal collisions occurred on straight and level roads, 27 percent occurred on a curve, and 26 percent occurred on a gradient. For injury collisions, 72 percent occurred on straight and level roads. For property damage collisions, 78 percent occurred on straight and level roads.

By comparison in the 5-Year Analysis, 58 percent of fatal collisions occurred on straight and level roads, 26 percent occurred on a curve, and 25 percent occurred on a gradient. For injury collisions, 74 percent occurred on straight and level roads. For property damage collisions, 79 percent occurred on straight and level roads.

4.5.2. Discussion and Recommendations

The 20-Year and 5-Year Analyses produced similar results. Straight and level roads were where most collisions were occurring. However, locations where there are curves and hills on the road played a significant part in several fatal collisions and should be addressed as well.

Straight and level roads may appear to be the safest road alignment to a driver. However, this may not be the case. Long sections of straight and level roadways have the potential to become monotonous to drivers. It can result in a driver becoming over confident and driving over the speed limit or it could result in a driver becoming fatigued or hypnotized by the road because of a lack of brain stimulation. A way to avoid this from happening would be to design the roadway with aesthetics that are pleasing visually for the driver such as the addition of gradual horizontal and/or vertical curves that would force drivers to pay more attention to the roadway.

Although curves and hills may provide a benefit to drivers by adding interest to the roadway, they can also be dangerous if not designed properly. Specific countermeasures that could increase the safety through curves and gradients are, improved roadway side slopes, flattened horizontal or vertical curves, climbing lanes, speed warning signs, and reflectorized guide posts through horizontal curves.

4.6. Road Configuration

4.6.1. Main Findings

Nova Scotia, New Brunswick, Newfoundland, Prince Edward Island and Alberta do not have reliable data for this variable and were taken out of the analysis. Also, property damage collisions from Quebec do not collect this variable and were not included.

In order to calculate the percentage of collisions at intersections, three data values were used (Intersection of at least two public roadways, intersection related by traffic control influence, and intersection with private driveway or laneway).

In the 20-Year Analysis, 65 percent of fatal collisions occurred at non-intersections whereas 32 percent occurred at intersections, 58 percent of injury collisions occurred at intersections whereas 40 percent occurred at non-intersections, and 52 percent of property damage collisions occurred at intersections whereas 41 percent occurred at non-intersections.

By comparison, in the 5-Year Analysis, 62 percent of fatal collisions occurred at non-intersections whereas 29 percent occurred at intersections, 58 percent of injury collisions occurred at intersections whereas 40 percent occurred at non-intersections, and 54 percent of property damage collisions occurred at intersections whereas 43 percent occurred at non-intersections.

4.6.2. Discussion and Recommendations

Based on both the 20-Year and 5-Year Analyses, it appears that fatal collisions occur more often at non-intersections and injury and property damage collisions occur more often at intersections.

Non-intersection collisions could include head-on collisions, run off the road collisions, rear-end collisions, or hitting an object or person collision. Please refer to countermeasures recommended under Collision Configuration and Road Category to address these collision types.

Intersection collisions often result in fatalities as well. They may be caused by aggressive drivers or drivers not obeying the traffic control such as running the red light. However they could also occur because the intersection was poorly designed. Rear-end, sideswipe, and right-angle collisions, and collisions involving a pedestrian are often common at intersections. Specific countermeasures that may be implemented to address these collisions are, adding or improving left-turn and/or right turn channelization, realigning opposing lane approaches to provide better sight distance for left-turn drivers, moving the intersection away from a curve, increasing surface friction on downhill approaches, providing a median, providing pavement marking guidance lines for turning movements, improving intersection sight distance by removing objects such as trees or billboard signs, providing transverse markings or rumble strips on the approach to the intersection, improving the road lighting, restricting turning movements, providing intersection Stop Ahead or Signal Ahead warning signs, removing on-street parking near the intersection, installing a roundabout, providing Stop or Yield signs to uncontrolled intersections, and providing grade separation. For countermeasures specifically

related to signalized intersections and stop-controlled intersections, please refer to the Traffic Control data element.

4.7. Road Surface Condition

4.7.1. Main Findings

In the 20-Year Analysis, 67 percent of fatal collisions occurred on dry, normal roads, 16 percent occurred on wet roads and 11 percent occurred on winter road surface conditions (snow, ice, slush). For injury collisions, 62 percent occurred on dry, normal roads, 20 percent occurred on wet roads, and 12 percent occurred on winter road surface conditions. For property damage collisions, 55 percent occurred on dry normal roads, 19 percent occurred on wet roads, and 19 percent occurred on winter road surface conditions.

By comparison, in the 5-Year Analysis, 68 percent of fatal collisions occurred on dry, normal roads, 16 percent occurred on wet roads, and 12 percent occurred on winter road surface conditions. For injury collisions, 65 percent occurred on dry normal roads, 19 percent occurred on wet roads, and 12 percent occurred on winter road surface conditions. For property damage collisions, 61 percent occurred on dry, normal roads, 17 percent occurred on wet roads, and 17 percent occurred on winter road surface conditions.

4.7.2. Discussion and Recommendations

The 20-Year and 5-Year Analyses showed similar results. Wet and snowy/icy/slushy roads are more of an issue for injury and property damage collisions than they are for fatal collisions. To address these types of collisions, municipalities should have adequate snow removal plans in place such as an adequate number of snow ploughs to accommodate the roads and the ability to monitor road surface conditions so that they are salted in a timely manner. Variable message signs or permanent warning signs should be installed in locations where slippery conditions occur often such as on bridges.

4.8. Collision Hour

4.8.1. Main Findings

In the 20-Year Analysis, most fatal, injury and property damage collisions occurred between the hours of 3:00 and 5:59 pm, with 18 percent, 25 percent, and 22 percent, respectively.

By comparison, in the 5-Year Analysis, most fatal, injury and property damage collisions occurred between the hours of 3:00 and 5:59 pm, with 19 percent, 25 percent, and 23 percent, respectively.

4.8.2. Discussion and Recommendations

Based on both analyses, it is quite obvious that the afternoon rush hour period is the most common time for all types of collisions. This is definitely an issue that needs to be addressed. Increased congestion in several large cities across Canada has resulted in longer commutes for drivers, driver frustration, and even aggressive driving. Other modes of transportation other than the use of personal vehicles should be encouraged by providing facilities such as

convenient and adequate transit services, designated bicycle lanes, and carpooling programs. If possible, offices should encourage flexible working hours or telecommuting. Increased police enforcement during this time of day is also encouraged.

4.9. Day of Week

4.9.1. Main Findings

In the 20-Year Analysis, most fatal collisions (52 percent) occurred on Friday, Saturday, or Sunday, most injury collisions (47 percent) occurred on Thursday, Friday, or Saturday, and most property damage collisions (48 percent) occurred on Thursday, Friday, or Saturday.

By comparison, in the 5-Year Analysis, most fatal collisions (50 percent) occurred on Friday, Saturday, or Sunday, most injury collisions (46 percent) occurred on Wednesday, Thursday, or Friday, and most property damage collisions (47 percent) occurred on Wednesday, Thursday, or Friday.

4.9.2. Discussion and Recommendations

The results of both analyses showed that most fatal collisions occurred on the weekend and most injury and property damage collisions occurred near the end of the week. Vehicle exposure to the road plays a large part in these results. People are out later in the evenings on the weekend and there are higher traffic volumes (vehicle and pedestrian) during those times. Increased police enforcement and police enforcement specifically related to drinking and driving is recommended. Educational campaigns related to pedestrian safety and drinking and driving is also recommended. The reason for more injury and property damage collisions occurring on Wednesday and Thursday as opposed to Monday and Tuesday is unknown but further research on these results is recommended.

4.10. Month of Collision

4.10.1. Main Findings

In the 20-Year Analysis, most fatal collisions (52 percent) occurred in June, July, or August, most injury collisions (28 percent) occurred in June, July, or August, and most property damage collisions (33 percent) occurred in November, December, or January.

By comparison, in the 5-Year analysis, most fatal collisions (30 percent) occurred in July, August, and December, most injury collisions (27 percent) occurred in July, August, and December, and most property damage collisions (32 percent) occurred in November, December, and January.

4.10.2. Discussion and Recommendations

Both analyses had similar results except that in the 5-Year Analysis, December was one of the top three months for fatal and injury collisions occurring. However, overall the summer months were more common for fatal collisions and the winter months were more common for injury and property damage collisions. Vehicle exposure in the summer months plays a significant role in these results. Not only are more families travelling and taking vacations

while children are out of school, more pedestrians would be outside using the roadway and taking advantage of the warmer weather. Educational campaigns targeting highway travelling as well as pedestrian safety is recommended. In the winter months, road surface conditions play a significant role in causing collisions. Slippery, icy roads can result in increases in a number of different types of collisions by drivers unable to stop fast and losing control of their vehicle. It is recommended that roads are salted adequately when required and that winter safety educational campaigns are implemented in jurisdictions.

4.11. Light Condition

4.11.1 Main Findings

In the 20-Year Analysis, 51 percent of fatal collisions occurred during daylight and 44 percent occurred in the dark or with artificial light present. For injury collisions, 67 percent occurred during daylight and 29 percent occurred in the dark or with artificial light present. For property damage collisions, 51 percent occurred during daylight and 30 percent occurred in the dark or with artificial light present.

By comparison, in the 5-Year Analysis, 54 percent of fatal collisions occurred in the daylight and 41 percent occurred in the dark or with artificial light present. For injury collisions, 69 percent occurred during daylight and 27 percent occurred in the dark or with artificial light present. For property damage collisions, 66 percent occurred during daylight and 30 percent occurred in the dark or with artificial light present.

4.11.2. Discussion and Recommendations

Both analyses showed that even though the majority of collisions occurred during daylight, a significant amount occurred in the evening, especially fatal ones. Roads should be assessed to determine if better road lighting would be beneficial for specific locations where there are a high number of collisions that occur during dark hours. Also, signs and pavement markings should be adequately reflectorized.

4.12. Traffic Control

4.12.1 Main Findings

Quebec does not collect property damage collisions for this variable. Also, although Manitoba, Newfoundland, and Nova Scotia were included in the analysis, there were a significant number of their collisions that had an unknown traffic control.

In the 20-Year Analysis, 79 percent of fatal collisions occurred where there was no traffic control present, 60 percent of injury collisions occurred where there was no traffic control present whereas 32 percent occurred at either stop signs or traffic signals, and 68 percent of property damage collisions occurred where there was no traffic control present whereas 28 percent occurred at either stop signs or traffic signals.

By comparison in the 5-Year Analysis, 79 percent of fatal collisions occurred where there was no traffic control present, 57 percent of injury collisions occurred where there was no traffic control present whereas 37 percent occurred at stop signs or traffic signals, and 65 percent of

property damage collisions occurred where there was no control present whereas 28 percent occurred at stop signs or traffic signals.

4.12.2. Discussion and Recommendations

According to the results of both analyses, most fatal collisions occurred where there was no traffic control present. However, for injury and property damage collisions, collisions at either stop signs or traffic signals become a problem. To address collisions at signalized intersections, there are a number of countermeasures that could be implemented such as actuated signal operations, adequate intergreen time, signal progression or coordination, protected left-turn movements, protected right-turn movements, restriction of right-turns on red, larger signal displays, relocation of signal head to increase the level of conspicuity, yellow backplates on signal heads, advanced warning flashers, and removal of the signal if it is unwarranted. Specific countermeasures to address collisions at intersection with stop signs would be signalizing the intersection, upgrading the intersection from a Two-Way Stop to a Four-Way Stop control, and providing overhead flashing lights.

4.13. Speed Limit

4.13.1. Main Findings

Alberta does not report the posted speed limit at the collision site; therefore the province was removed from the analysis. Quebec's property damage collisions were also not available.

In the 20-Year Analysis, 29 percent of fatal collisions occurred in 80 km/h speed limit zones, 22 percent occurred in the 50 km/h speed limit zones, and 21 percent occurred in 90 km/h speed limit zones. For injury collisions, 54 percent occurred in 50 km/h speed limit zones. For property damage collisions, 53 percent occurred in 50 km/h speed limit zones.

By comparison, in the 5-Year Analysis, 27 percent of fatal collisions occurred in 80 km/h speed limit zones, 21 percent occurred in 50 km/h speed limit zones, and 20 percent occurred in 90 km/h speed limit zones. For injury collisions, 57 percent occurred in 50 km/h speed limit zones. For property damage collisions, 47 percent occurred in 50 km/h speed limit zones.

4.13.2. Discussion and Recommendations

It is apparent from the analyses that fatal collisions occur more often in 80 km/h speed limit zones and injury and property damage collisions occur more often in 50 km/h speed limit zones. These results may be compared to the results under the Road Classification data element where more fatal collisions occurred on rural roads and more injury and property damage collisions occurred on urban roads. Please refer to the Road Classification data element for recommended countermeasures associated with these collisions.

4.14. Driver Condition Contributing Factor

4.14.1. Main Findings

Quebec does not collect data for this variable and was therefore left out of the analysis.

In the 20-Year Analysis, for vehicles involved in fatal collisions, 69 percent of drivers were apparently normal, 20 percent had been drinking or were impaired by alcohol, and 7 percent were inattentive. For vehicles involved in injury collisions, 84 percent of drivers were apparently normal, 8 percent were inattentive, and 5 percent had been drinking or were impaired by alcohol. For vehicles involved in property damage collisions, 88 percent of drivers were apparently normal, 7 percent were inattentive, and 3 percent had been drinking or were impaired by alcohol.

By comparison, in the 5-Year Analysis, for vehicles involved in fatal collisions, 71 percent of drivers were apparently normal, 16 percent had been drinking or were impaired by alcohol, and 8 percent were inattentive. For vehicles involved in injury collisions, 84 percent of drivers were apparently normal, 10 percent were inattentive, and 4 percent had been drinking or were impaired by alcohol. For vehicles involved in property damage collisions, 89 percent of drivers were apparently normal, 7 percent were inattentive, and 2 percent had been drinking or were impaired by alcohol.

4.14.2. Discussion and Recommendations

Overall, the analysis showed that most vehicles involved in collisions involved drivers that were apparently normal. However, drinking and driving appeared to stand out as well for vehicles involved in fatal collisions and inattention was a factor for all types of collisions. Stricter penalties for drinking and driving, increased police enforcement, and awareness campaigns are recommended. It is also recommended that restrictions be made from using cell phones while driving.

4.15. Driver Action Contributing Factor

4.15.1. Main Findings

Quebec does not collect data for this variable and was therefore left out of the analysis.

In the 20-Year Analysis, for vehicles involved in fatal collisions, 59 percent of drivers did not conduct an improper action and 16 percent exceeded the speed limit or were driving too fast for conditions. For vehicles involved in injury collisions, 64 percent of drivers did not conduct an improper action, 8 percent failed to yield the right-of-way, and 7 percent were following too closely. For vehicles involved in property damage collisions, 69 percent of drivers did not conduct an improper action, 7 percent failed to yield the right-of-way, and 4 percent were following too closely.

By comparison, in the 5-Year Analysis, for vehicles involved in fatal collisions, 62 percent of drivers did not conduct an improper action and 13 percent exceeded the speed limit or were driving too fast for conditions. For vehicles involved in injury collisions, 64 percent of drivers did not conduct an improper action, 8 percent failed to yield the right-of-way, and 8 percent

were following too closely. For vehicles involved in property damage collisions, 71 percent of drivers did not conduct an improper action, 7 percent were following too closely, and 6 percent failed to yield the right-of-way.

4.15.2. Discussion and Recommendations

It is important to note that the contributing factors in this analysis could not be used to determine the cause of the collision. They only represent factors that may have contributed to the collision.

The analyses show that the majority of vehicles involved in collisions did not include a driver conducting an improper action. However, exceeding the speed limit or driving too fast for conditions appears to be a major driver action contributing factor for vehicles involved in fatal collisions. Although some of these collisions originate from aggressive driving behaviour, many could result from misleading messages that drivers are receiving from the road design. It is recommended that positive guidance be considered in the design of all new roads and evaluated for existing road where there is a significant number of speed related crashes.

For vehicles involved in injury and property damage collisions, drivers failing to yield the right of way and drivers following too closely are the two driver action contributing factors that stood out. Drivers failing to yield the right of way could be the result of driver inattention/distraction, slow driver perception-reaction time (especially for older drivers), or the result of aggressive driving behaviours where drivers do not obey traffic controls. Drivers following too closely are signs of aggressive driving. Countermeasures such as restrictions of cell phone use in vehicles, vision testing for older drivers, and stricter penalties for aggressive driving are recommended.

4.16. Age

4.16.1. Main Findings

In the 20-Year Analysis, the age group that had the most persons killed in collisions was 25 to 34 accounting for 18 percent of fatalities. It is also significant to mention that 26 percent of persons killed in collisions were between the ages of 15 and 24. The age group that had the most persons injured in collisions was 25 to 34 accounting for 19 percent of injuries. Also, 27 percent of persons injured in collisions were between the ages of 15 and 24.

By comparison, in the 5-Year Analysis, the age group that had the most persons killed in collisions was 65 + accounting for 18 percent of fatalities. It is also significant to mention that 25 percent of persons killed in collisions were between the ages of 15 to 24. The group that had the most persons injured in collisions was 25 to 34 accounting for 19 percent of injures. Also, 27 percent of persons injured in collisions were between the ages of 15 and 24.

4.16.2. Discussion and Recommendations

It appears from the analyses that older persons are increasingly becoming involved in fatal collisions. Their reduced perception-reaction time and possible vision disabilities produce a risky situation for driving. Regular vision tests should be mandatory for drivers aged 65 +. Young drivers are also a concern because of their inexperience and risk-taking characteristics.

More education campaigns in high schools warning of the potential dangers of driving should be implemented.

4.17. Gender

4.17.1. Main Findings

In the 20-Year Analysis, 69 percent of persons killed were male and 31 percent were female. For persons injured in collisions, 51 percent were male and 48 percent were female.

By comparison, in the 5-Year Analysis, 69 percent of persons killed were male and 31 percent were female. For persons injured in collisions, males and females were evenly split at 50 percent.

4.17.2. Discussion and Recommendations

In both analyses, for persons killed in collisions, males were more common than females. For persons injured in collisions, there is about a 50-50 split between males and females. It is recommended that all awareness campaigns be targeted towards both male and female drivers.

5. CONCLUSIONS

Canada's Road Safety Vision 2010 has a national goal of making Canadian roads the safest in the world. In order to achieve this goal it is necessary to observe trends in past collision data to determine what features of the road system require improvement. This study looked at a number of collision data elements available in Transport Canada's Traffic Accident Information Database in order to determine the road system features where collisions occurred. Based on the results of a 20-Year and 5-Year Collision Analyses, the priority topics that require attention in addressing fatal collisions in Canada were collisions where a motor vehicle hit an object or person, head-on collisions, undivided roads, rural roads, afternoon rush hour periods, weekends, summer months, dark hours, drinking and driving, driver inattention, speeding, male drivers, young drivers, and elderly drivers.

Priority topics that require attention in addressing injury and property damage collisions include collisions where a motor vehicle hit an object or person, rear-end collisions, undivided roads, urban roads, intersections, afternoon rush hour periods, end of the week, summer and winter months, driver inattention, drinking and driving, drivers failing to yield the right of way, young drivers, and both male and female drivers.

The countermeasures recommended throughout this report are only suggestions and are not necessarily representative of the opinions of Transport Canada. Collision locations would have to be evaluated and assessed in order to determine what measures would apply and be feasible to implement in order to reduce the number and severity of collisions as cost effectively as possible. Conducting road safety audits on roads that have not been built yet but are in the planning, design or construction stage is a way of addressing safety issues proactively and preventing collisions from occurring.

Research should continue in the area of collision trends over time with more recent Canadian collision data. Values in the data elements should be analyzed further in order to narrow down specific causes and characteristics of collisions in order to recommend the necessary countermeasures to increase the safety on Canadian roads.

6. REFERENCES

Zein, S and Montufar J. (2003). Roadway Safety Benchmarks Over Time. Final Report prepared for Transport Canada.

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Transport Canada and Canadian Council of Motor Transport Administrators (2006). Road Safety Vision 2010. 2005 Annual Report.

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7. Appendix A - List of Values

7.1. Collision Severity
Fatal
Injury
Property Damage

7.2. Collision Configuration
One motor vehicle involved: hit person or object
One motor vehicle involved: ran off left shoulder
One motor vehicle involved: ran off right shoulder
Two motor vehicles travelling in the same direction: rear-end collision
Two motor vehicles travelling in the same direction: sideswipe
Two motor vehicles travelling in the same direction: one vehicle passing to the left of the other or there was a left turn conflict
Two motor vehicles travelling in the same direction: one vehicle passing to the right of the other or there was a right turn conflict
Two motor vehicles travelling parallel to each other but in opposite directions: head-on collision, sideswipe
Two motor vehicles travelling in different directions: left turn across opposing traffic
Two motor vehicles travelling in different directions: right turn, including conflicts at intersections
Other configuration

7.3. Road Category
Undivided
Divided
Freeway
Interchange Ramp

Other category

7.4. Road Classification
Urban
Rural
Other place

7.5. Road Alignment
Straight and level
Straight and gradient
Curved and level
Curved and gradient
Top of hill
Bottom of hill
Other alignment

7.6. Road Configuration
Non-intersection
Intersection of at least two public roadways
Intersection related by traffic control influence
Intersection with private driveway or laneway
Rail road level crossing
Bridge, overpass or viaduct
Tunnel/underpass
Parking lot
Off road
Other site

7.7. Road Surface Condition
Dry, normal
Wet
Snow (loose)
Ice (packed snow)
Slippery
Sand/gravel, dirt
Mud (wet)
Slush
Oil
Other conditions

7.8. Collision Hour
12:00 to 12:59 am
1:00 to 1:59 am
2:00 to 2:59 am
3:00 to 3:59 am
4:00 to 4:59 am
5:00 to 5:59 am
6:00 to 6:59 am
7:00 to 7:59 pm

8:00 to 8:59 am
9:00 to 9:59 am
10:00 to 10:59 am
11:00 to 11:59 am
12:00 to 12:59 pm
1:00 to 1:59 pm
2:00 to 2:59 pm
3:00 to 3:59 pm
4:00 to 4:59 pm
5:00 to 5:59 pm
6:00 to 6:59 pm
7:00 to 7:59 pm
8:00 to 8:59 pm
9:00 to 9:59 pm
10:00 to 10:59 pm
11:00 to 11:59 pm

7.9. Day of Week
Sunday
Monday
Tuesday
Wednesday
Thursday
Friday
Saturday

7.10. Month of Collision
January
February
March
April
May
June
July
August
September
October
November
December

7.11. Light Condition
Day
Dawn
Dusk
Dark
Artificial Road Light
Other lighting

7.12. Traffic Control
No traffic control present
Traffic signals
Stop sign
Yield sign
Pedestrian crossover
Police officer
School guard, flagman
School crossing
Flashing signal light
Advisory sign
School bus, stopped with lights flashing
Railway crossing
Other control type

7.13. Speed Limit
10 km/h
20 km/h
30 km/h
40 km/h
50 km/h
60 km/h
70 km/h
80 km/h
90 km/h
100 km/h
110 km/h
Other speed limit

7.14. Driver Condition Contributing Factor
Inattention, distraction
Inexperience, confusion
Fatigue
Fell asleep
Lost consciousness
Sudden illness
Medical or physical disability
Been drinking
Impaired by alcohol
Impaired by illicit drugs
Impaired by prescription drugs
Impaired, unspecified agent
Suicide attempt
Apparently normal

7.15. Driver Action Contributing Factor
Following too closely
Turning improperly
Driving too fast for conditions

Exceeding speed limit
Passing, changing lanes improperly
Failed to yield right-of-way
Disobeyed traffic control device
Driving in wrong direction
Backing unsafely
Lost control
Pedestrian error
Failed to signal
Lights not used
No apparent improper action

7.16. Age
00-04
05-14
15-24
20-24
25-34
35-44
45-54
55-64
65+

7.17. Gender
Female
Male