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The effect of Operation 24 Hours on reducing collision in the City of Edmonton

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ABSTRACT

In the City of Edmonton, in order to reduce the prevalence of collisions, the Operation 24 Hours program (OPS24) was developed by using existing police and transportation services resources. The program uses traditional manned police speed enforcement method, which are supplemented by traffic safety messages displayed on permanent and mobile dynamic messaging signs (DMS). In this paper, collision data analysis was performed by looking at the daily number of collisions from 2008 to 2011 that covers 28 Operation 24 Hours (OPS24) events. The objective of the collision data analysis is to analyze if there is a reduction in collision frequencies after OPS24 was held and examined how long the collision reduction effect last. Weather factors such as temperature, thickness of snow, and wind gust have been considered by many as a great influence on collision occurrences, especially in a city with long and cold winter such as Edmonton. Therefore, collision modeling was performed by considering these external weather factors. To analyze the linear and periodic trend of different collision types (injury, fatal, and property damage only (PDO)) and examine the influence of weather factors on collisions, negative binomial time series model that accounts for seasonality and weather factors was used to model daily collision data. The modeling also considered collision proportion to account for missing traffic volume data; the Gaussian time series model that accounts for seasonality and weather factors was used to model collision proportion. To estimate the collision trend and test for changes in collision levels before/after OPS24, interrupted time series model with segmented regression was used. While for estimating how long the effect of the OPS24 last, change point method was applied.

1. Introduction

Many researchers have considered weather factors as a great influence on collision occurrences. Poor weather-related driving conditions are associated with 7000 fatalities, 800,000 injuries, and more than 1.5 million vehicular collisions annually in the United States (National Research Council, 2004). Adverse weather is present in 28% of total collisions and nearly 20% of highway fatalities (Weather and Highways, 2004). Analysts estimate the economic toll of weather-related collisions at $42 billion (Lombardo, 2000). In Canada, weather-related collisions have been estimated to cost Canadians an average of approximately CDN$ 1 billion per year (Andrey et al., 2001; Usman et al., 2011). Understanding the effects of adverse weather on motor vehicle collisions matters because experts have identified a number of communications and engineering innovations (largely technologies to collect and communicate real time road condition information, such as sensors and dynamic message signs) that could significantly reduce the collision and injury rates, but at a potentially substantial cost (National Research Council, 2004; Weather and Highways, 2004).

It is a known fact that collisions can be influenced by external environmental variables such as temperature, snowfall level, and wind gust. Previous studies have associated precipitation with markedly increased collisions rates (Eisenberg, 2004; Brodsky and Hakkert, 1988; Andrey and Yagar, 1993; Fridstrom et al., 1995). Recent work also shows that the risk posed by precipitation rises dramatically with the time since last precipitation (Eisenberg, 2004). There has not been any study on the effect of snowfall.

Number of collisions is not inevitably higher in snowy weather than in dry weather. On the one hand, snow makes driving more dangerous; by reducing tire adherence and impairing visibility. On the other hand, experienced drivers typically drive more slowly and carefully in snowy weather, and many people avoid or postpone unnecessary travel. Perhaps as a reflection of these offsetting factors, the handful of published studies addressing the collision consequences of snow has produced some conflicting results. The

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Table 1
2008–2011 OPS24 schedules.

2008	2009	2010	2011
	Thursday, January 29	Wednesday, January 20	Wednesday, January 19
	Tuesday, March 10	Friday, February 05	Friday, February 04
	Tuesday, April 07	Monday, March 29	Monday, March 28
	Tuesday, May 12	Tuesday, April 13	Thursday, April 21
	Tuesday, June 09	Monday, June 28	Thursday, May 19
	Friday, June 26		Tuesday, June 07
Monday, September 15	Tuesday, September 29	Monday, September 13	
Tuesday, October 21	Friday, October 16	Monday, November 15	Tuesday, November 15
Tuesday, December 16	Tuesday, December 15	Tuesday, December 14	Friday, December 16

weight of the evidence suggests that less severe collisions (e.g., those producing only property damage) increase during snowfall, while more severe collisions (those resulting in major injuries or fatalities) decrease.

Significantly increased collision rates have been documented in snowy months in Canada (Andreescu and Frost, 1998), on snowy days in the United Kingdom (Perry et al., 1991), and during snowstorms in Iowa, United States (Knapp et al., 2000). Perry et al. (1991) found increased rates of collisions involving injuries and fatalities on snowy days in the United Kingdom, but Brown and Baass (1997) noted fewer collisions involving injuries in the winter months in Canada, as did Fridstrom et al. (1995) in snowy months in Denmark and Finland. Eisenberg (2004) found decreased rates of fatal collisions on snowy days in the United States, a finding echoed in analysis of winter months in Canada (Brown and Baass, 1997) and snowy months in Scandinavia. To date, only two previous studies have examined the effects of the first snowfall of the season. Defining first snowfall as the first snow in a month following a month without snow, Fridstrom and Ingebrigtsen (1991) found significant increases in both injury and fatal collisions in Norway. Subsequently, however, research by Fridstrom et al. (1995) produced mixed findings: Injury collisions rose significantly during the winter's first month with snow (compared with other months with snow) in Denmark but not in either Finland or Norway. Fatality rates were no different in the first snowy month than in other snowy months.

1.1. The Operation 24 Hours

In the City of Edmonton, in order to reduce the prevalence of speed related collisions, the Operation 24 Hours program (OPS24) was developed by using existing police and transportation services resources. The program uses traditional police speed enforcement methods such as manned enforcement, which are supplemented by traffic safety messages displayed on permanent and mobile dynamic messaging signs (DMS). The program utilizes an alternating two-message approach "Big Ticket Event – Don't Speed". The messages were run consecutively for four days prior to the operation day and also during the operation day (the fifth day). During the OPS24, the entire City of Edmonton became an enforcement zone. Twenty-eight OPS24 events have been conducted during 2008–2011 (see Table 1).

The objectives of this study are to examine the impact of OPS24 on collisions in general as well as on different collision types (injury, fatal, and property damage only (PDO)). The collision analysis did not limit to speed related collisions since the Edmonton Police Service collected speed information of vehicles involved in a collision only starting from 2011 and only if the police visited the collision scene. The collected speed information is also only categorical: unsafe speed, no unsafe speed, unknown, and not applicable. General collision trend and the influence of weather factors such as temperature, thickness of snow, and wind gust were also investigated. In addition, we aim to find how long the collision reduction lasts. The impact of OPS24 on vehicle speed distribution is beyond the scope of this paper and can be found in Halim et al. (2012).

2. Data

This study used 3 years and 4 months of daily collision data ranging from September 2008 to December 2011. The collision data used in this analysis was obtained from the City of Edmonton's Motor Vehicle Collision Information System (MVCIS), a database of motor vehicle collisions that occur on public roads in the City of Edmonton. The information in the database is collected from the provincial Collision Report Form, which is completed by members of the Edmonton Police Service (EPS) either on paper at the scene of the collision or electronically at the front counter of a divisional or community police station. The collision reports received from the EPS were reviewed and corrected if necessary (in consultation with the EPS) before entered into MVCIS.

The total number of collisions was 109,459 during this period. The daily collision dataset contains collision frequencies, collision types (injury, fatal, and PDO), collision locations, roadway portions, and collision causes. We combined fatal and injury collisions and named it 'severe collisions' which contributes 14.6% to the total collisions. The statistical summary of the data is presented in Table 2.

2.1. Weather data

The weather data used in this analysis includes 3 years and 4 months of daily weather data of the City of Edmonton from Environment Canada with dates ranging from September 2008 to December 2011. The daily weather data contains variables such as daily maximum, minimum and mean temperatures in degree Celsius, the thickness of snow on the ground (in cm), and the speed of maximum wind gust during the day (in km/h). The statistical summary of the weather data is shown in Table 3.

Both MVCIS and Environment Canada provide reliable data for purpose of this study. The completeness and accuracy of data are significantly high, for example, no unknown information about the

Table 2
Summary of collision data.

	Minimum	Maximum	Mean	Std deviation
Number of collisions per day	13	305	75.13	35.24
Severe collisions per day	1	36	10.98	4.69
PDO collisions per day	12	286	64.08	32.63