

Emergency Motor Vehicle Crashes in British Columbia: Myth or Reality?



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Executive Summary

When emergency vehicle collisions occur, especially at speed with lights and siren, they tend to evoke heightened media attention as well as public concern and interest. While these concerns are understandable given the sheer size and mass of heavy emergency vehicles (i.e., fire/ladder trucks) relative to much lighter, non-emergency vehicles, such concerns must be placed into context. Emergency vehicle crashes may potentially lead to tragic outcomes, especially when heavy vehicles traveling at speed are involved. However, accidents involving emergency vehicles in BC are infrequent; most are of a minor nature and incur property damage only. The intent of this study is to look at the evidence related to the current discussion around emergency vehicle crashes. These crashes are often linked to casualties, specifically fatalities or injuries. In regards to certain types of emergency vehicles such as fire/ladder trucks operating in Greater Vancouver, precisely the kind of vehicle that can inflict extensive damage in busy urban settings, it should be noted that such crashes are extremely rare. Given the high profile of emergency vehicle crashes, together with 24/7 news coverage and the prevalence of social media, they may appear more common to the public than they actually are.

- Emergency vehicle crashes in British Columbia represent an almost immeasurably or incalculably small fraction of non-emergency vehicle crashes reported in BC and continue to decline in most regions across the province, especially in the Lower Mainland. In examining percent changes between 2009 to 2012, emergency vehicle crashes have steadily declined. Specifically, there has been an 18 percent decrease in the number of emergency vehicle crashes in BC from 2009 to 2012, and a 17 percent decrease in the Lower Mainland.
- In examining emergency vehicle collisions involving casualties in BC from 2009 to 2012, there have been notable reductions across most sectors. These involved single- and multi-vehicle emergency vehicle collisions with casualties, and include lights and siren calls. While the provincial and Lower Mainland percentiles for non-emergency vehicle crashes have trended upward, emergency vehicle crashes in the high severity index declined. For example, there has been a 22 percent decrease in the number of emergency vehicles crashes in BC from 2009 to 2012, and a 19 percent decrease in the Lower Mainland. Significantly, BCAS ambulance incidents in the high severity range, specifically single- and multi-vehicle emergency vehicle collisions with casualties have been noticeably low during this period.
- In terms of casualty crashes in the Lower Mainland, there was only 1 reported accident involving an ambulance from 2008 to 2012, compared to 8 incidents involving fire/ladder trucks during the same period. Having said this, accidents involving heavy fire trucks is expected to decrease. A linear regression of fire/ladder truck crashes in Greater Vancouver indicate a statistically-significant decline, an R^2 0.9622 with a line of best fit. All other things being equal or held constant, it is extrapolated that 13 fire/ladder truck crashes will occur in 2018. In essence, emergency vehicle crashes are declining and trending downward, and this is reflected in metropolitan areas of BC.

Introduction

Overview

Emergency vehicle operators are generally more highly-trained than other drivers in the province of British Columbia (BC). However, their driving can occur under infinitely more stressful and demanding conditions, and can occasionally involve unavoidable travel at a high rate of speed. The challenges facing emergency crews are often exacerbated by a variety of physical and environmental factors beyond their control, and may include adverse road and weather conditions, traffic volume, and unforeseen events. There is a public expectation that emergency vehicles (EVs) are driven in a safe and lawful manner, and that operators meet or exceed industry driving standards and abide by operational guidelines, the *Motor Vehicle Act*, and related statutes. The public expects Emergency Vehicle Operators (EVOs) to adhere to high standards, avoid taking unnecessary or irresponsible risks, and respond to emergencies in a timely and efficient manner. Nevertheless, the very act of responding to emergency calls contains inherent risks and while every reasonable measure can be taken to avoid traffic accidents, it is impossible to guarantee zero risk, and accidents will inevitably occur. Understanding the frequency, severity, and future of emergency vehicle accidents in BC is essential to addressing the underlying risks and developing the necessary standards and policy to minimize the potential for accidents and enhance road safety.

Rationale

Recent developments in service protocols involving emergency services, in particular the BC Ambulance Services (BCAS), have raised questions about crew safety when responding to emergency calls. On October 29, 2013 the BC Emergency Health Services (BCEHS) implemented a change to their BC Ambulance Service Resource Allocation Plan (RAP) resulting in 74 incident codes being downgraded to routine Code 2 calls instead of their previous designation as lights and siren calls. BCEHS has maintained that the changes were made to optimize the use of resources in a manner that prioritizes the allocation of resources based on the most emergent needs (Dow, p. 2). It has been asserted that the downgrading of calls results in safer responses by lowering the number of calls being responded to with lights and siren. This statement implies that BCAS ambulance crashes are of underlying concern in policy discussions and possibly increasing in BC and, therefore, protocols are needed to further reduce the potential for accidents and enhance crew and civilian safety. The emergency vehicle crash data in BC which includes vehicles attending all types of calls, including lights and siren, does not support this contention. In fact, emergency vehicle incidents are infrequent and steadily declining across most regions of the province. In the five years leading up to BCEHS downgrading of calls in 2013, BCAS had significantly fewer incidents in the ambulance category relative to heavy vehicles utilized by fire services (i.e., fire/ladder trucks), keeping in mind these numbers are fairly low as well. It is not the intent of this study to question the findings of RAP; which has been done in other studies, but instead it offers empirical evidence relating to the frequency, severity, and future of emergency vehicle incidents in BC.

Discussion has recently centered on the safe and efficient operation of emergency vehicles in BC, and it has been asserted that fire service vehicles responding with lights and siren are potentially jeopardizing the public. The purpose of this study is to examine the frequency and severity of fire apparatus collisions relative to emergency vehicle crashes in other comparable sectors in BC, notably BC Ambulance Services. As a result, three specific questions are posed and underscore this report:

1. Has there been an increase in the frequency of emergency vehicle crashes from 2008 to 2012 in the province of British Columbia?
2. Has there been an increase in the severity of emergency vehicle crashes in the province of BC, and how does fire services and ambulance services statistics compare in this regard?
3. Are crashes of fire service vehicles, in particular fire/ladder trucks, likely to increase in the foreseeable future?

In order to answer these three questions, the scope of this research involved:

- Undertaking an analysis of relevant documentation including ICBC crash data, a brief literature review of existing academic and industry emergency vehicle crash studies as well as consultation with fire and rescue services in metropolitan regions of Canada.

Literature Review

A review of available literature reveals that emergency vehicle crash studies fall into three categories, namely: (1) bio-mechanical/engineering; (2) risk management; and (3) industry-related. The scope of crash studies is varied and diverse; they address theoretical and industry considerations, and are carried out by academics and domain experts alike. In examining crash data, some researchers have combined fire services, police departments, and ambulance services into a thematic category for analysis termed “emergency vehicle accidents” while others have analyzed incidents across identical types of organizations. While there are strengths and weaknesses in these varying methodological approaches, it is important to note that fire services, police departments, and ambulance services operate unique fleets of vehicles each with a specific mission and purpose. Additionally, each agency has specific response times and protocols for service delivery based, in part, on industry standards, national and provincial regulations, as well as local or municipal policy requirements.

Although sparse in number, there exist several useful studies pertaining to emergency vehicle crashes, in particular fire truck crashes. One notable study by Donoughe, Whitestone, and Gabler (2012) examined the injury and fatality risk of firefighters traveling in fire department vehicles by evaluating data from two datasets, namely the National Highway Traffic Safety Administration’s (NHTSA) Fatality Analysis Recording System (FARS) database and General Estimates System (GES). FARS and GES were used to compile a 10-year dataset of information on fire truck crashes. The study found that nearly two-thirds of fatal fire truck crashes involved either tripped or un-tripped rollovers. Previous studies have found that fire truck crashes are most common at intersections, in PM peak hours, and involved speeding and sudden passing maneuvers by the fire responders (Savolainen, Dey, Ghosh, Karra, and Lamb, 2009). A similar conclusion was reached in a 2007 national study of Royal Canadian Mounted Police (RCMP) police vehicle accidents by Plecas and Cohen, criminologists at the University of the Fraser Valley (UFV).

Scope of Research

Data Considerations

The emergency vehicle crash data examined in this report cover the period from 2008 to 2012 inclusive, and has been provided by the Insurance Corporation of British Columbia (ICBC), a provincial Crown Corporation that provides universal compulsory automobile insurance to drivers in BC. In addition to compiling crash data relating to ICBC-licensed motor vehicles in BC, the Corporation also collects data on emergency vehicle accidents in the following 5 administrative regions: (1) Fraser Valley; (2) Greater Vancouver; (3) North Central; (4) Southern Interior; and (5) Vancouver Island. Of note, the Lower Mainland refers to a grouping of the Greater Vancouver and Fraser Valley regions. Emergency vehicle crash data includes a severity index which codes incidents resulting in an injury or fatality (casualty), and incidents resulting in material damage only, meaning no injuries or fatalities (property damage only). Additionally, data reflects whether the motor vehicle accident was a single-vehicle incident or a multi-vehicle incident. A multi-vehicle incident resulting in an injury or fatality would score highest on the severity index.

Passenger vehicles are sedan-type motor vehicles that are licensed to the emergency service provider, and commercial vehicles are defined as: ambulance/emergency, box truck, crew cab and pick-up, fire/ladder truck, pumper, tank truck, and van. The emergency service provider licensee can be a municipal, provincial or federal entity operating service vehicles in BC. For this study, a “crash” is defined as any reportable adverse incident that causes vehicular property damage and/or injury to the crew or civilians. This is intended to include motor vehicle incidents that occur while crews are travelling to a scene, staging assets and/or working on-scene, and returning to their home facility. In addition, it reports both on-duty and off-duty collisions involving emergency vehicles and includes accidents at station or while on training exercises. These could involve relatively minor traffic mishaps while maneuvering the vehicle in parking lots or alleyways which accounts for the majority of insurance claims, or more complex accidents with privately-owned vehicles at roadways or intersections, potentially resulting in casualties and significant property damage with financial loss.

This report focuses primarily on commercial emergency vehicles of the type commonly used by fire departments and ambulance services, notably fire engines/ladders and ambulances, collectively known as first responders. These are the types of vehicles that typically respond with lights and siren to emergency calls, as well as with supervisory vehicles, and can inflict significant damage in the event of an accident. The ICBC category of passenger emergency vehicles presents some procedural challenges moving forward. Given the degree to which data aggregation exists in the category of emergency passenger vehicles, it is difficult to specify the exact number of crashed vehicles licenced to police, fire, and ambulance services as they all utilize passenger vehicles to a greater or lesser extent. Overall, RCMP and municipal police departments operate a larger fleet of passenger vehicles compared to fire and ambulance services, particularly in terms of general duty and patrol. Of note, fire departments and ambulance services also utilize passenger vehicles for administrative, supervisory, and inspection duties. However, few vehicles in the category of emergency passenger vehicles respond lights and siren to calls, except for those operated by Command staff, Battalion Chiefs, and BCAS supervisors.

Data Analysis

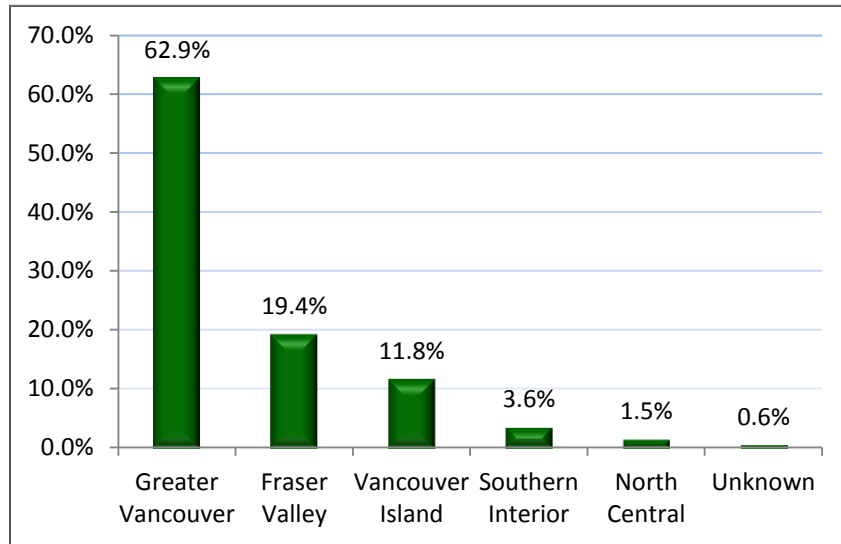
Emergency vehicle crashes in British Columbia represent an almost immeasurably or incalculably small fraction of non-emergency vehicle crashes reported in BC and continue to decline in most regions of the province, especially in the Lower Mainland. The Insurance Corporation of BC reported a total of 2,248 accidents in BC from 2008 to 2012, involving a wide variety of police, fire, and ambulance vehicles operating in the province. This figure represents the raw total, and includes both passenger and commercial vehicle types. A steady decrease in the total number of emergency vehicle crashes in BC was observed during the 5-year period, with a slight increase from 2011 (n=402) to 2012 (n=404). Both years contributed nearly equally to the sample of crashes (17.8 per cent for 2011 and 17.9 per cent for 2012). In examining percent changes from 2009 to 2012, emergency vehicle crashes had steadily declined. Figure 1 reveals there has been an 18 percent decrease in the number of of emergency vehicles crashes in BC from 2009 to 2012, and a 17 percent decrease in the Lower Mainland. In comparison, these percentage decreases are substantially lower than those observed for non-emergency vehicle incidents in the province and Lower Mainland.

Figure 1. Non-Emergency and Emergency Vehicle Crashes by Region in BC: 2009 to 2012

	2009	2010		2011		2012		2009-2012
British Columbia			<i>% change</i>		<i>% change</i>		<i>% change</i>	<i>% change</i>
All vehicles	270,000	260,000	-3.7	260,000	nil	260,000	nil	-3.7
Total EV crashes	493	445	-9.7	402	-9.6	404	0.5	-18
Lower Mainland								
All vehicles	180,000	170,000	-5.5	170,000	nil	170,000	nil	-5.5
Total EV crashes	406	366	-9.8	320	-12.5	335	4.6	-17
Vancouver Island								
All vehicles	36,000	37,000	2.7	36,000	-2.7	35,000	-2.7	-2.7
Total EV crashes	58	51	-12	55	7.8	49	-11	-15.5
Southern Interior								
All vehicles	37,000	36,000	-2.7	36,000	nil	36,000	nil	-2.7
Total EV crashes	15	20	33	20	nil	13	-35	-13
North Central								
All vehicles	16,000	15,000	-6.2	16,000	6.6	17,000	6.2	6.0
Total EV crashes	9	6	-33	4	-33	6	50	-33
Unknown								
All vehicles	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Total EV crashes	5	2	-60	3	50	1	-66	-80

Figure 2 below shows the distribution of emergency vehicle crashes by region with a 62.9 per cent concentration of incidents occurring in the Greater Vancouver area. The finding is not entirely surprising considering that 52.6 per cent of British Columbians (2008 to 2012) reside in Greater Vancouver, and the majority of emergency vehicles service the metropolitan area. Given the increased population growth and densification of urban places in BC, a continuing expansion of road networks coupled with greater numbers of licenced vehicles operating in the Lower Mainland, the potential for road accidents exist accordingly. Having said this, the number of emergency vehicle accidents in the Greater Vancouver is steadily declining, and will continue to decline for the foreseeable future.

Figure 2. Distribution of Emergency Vehicle Crashes reported to ICBC by Region: 2008 to 2012



To a large extent, the potential for accidents is mitigated by ongoing training and certification of emergency vehicle operators, helping them build the required skills, confidence, and knowledge to safely and effectively operate heavy equipment in built environments. Fire departments have annual proficiency standards for emergency vehicle operators to maintain their NFPA 1002 standard certification. Fire engines are much safer to operate today, numerous safeguards and technical redundancies are built into the vehicles, and the level of firefighter training and equipment maintenance has kept pace with the rigorous demands of the job.

Figure 3. Casualty Crashes of Emergency and Non-Emergency Vehicles reported to ICBC, by Lower Mainland and in BC: 2009 to 2012

	2009	2010		2011		2012		2009-2012
British Columbia			<i>% change</i>		<i>% change</i>		<i>% change</i>	<i>% change</i>
All vehicles	49,000	51,000	4	52,000	2	54,000	3.8	10
Total EV crashes	74	72	-2.7	62	-14.0	57	-8.0	-22
Lower Mainland								
All vehicles	35,000	36,000	2.8	37,000	2.7	38,000	2.7	8.5
Total EV crashes	62	63	1.6	53	-15.8	50	-5.6	-19

In examining emergency vehicle collisions involving casualties in BC from 2009 to 2012, there have been notable reductions from 2009 to 2012 across most sectors. These involved single- and multi-vehicle emergency vehicle collisions with casualties, and include lights and siren calls. While the provincial and Lower Mainland percentiles for non-emergency vehicle crashes have trended upward, total emergency vehicle crashes in the high severity index declined. Figure 3 shows there has been a 22 percent decrease in the number of emergency vehicles crashes in BC from 2009 to 2012, and a 19 percent decrease in the Lower Mainland. Significantly, BCAS ambulance incidents in the high severity range, specifically single- and multi-vehicle emergency vehicle collisions with casualties have been noticeably low during this period. In terms of casualty crashes in the Lower Mainland, there was only 1 reported accident involving an ambulance from 2008 to 2012, compared

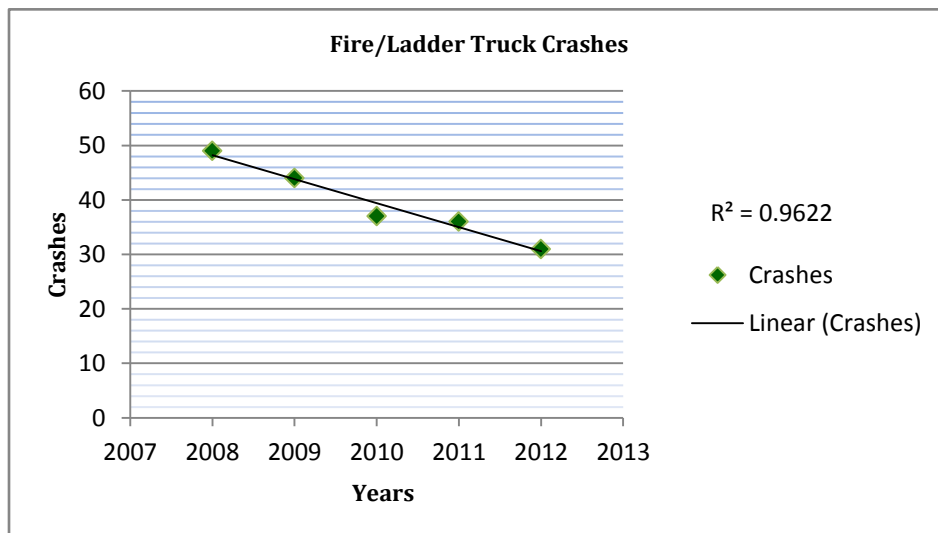
to 8 incidents involving fire/ladder trucks during the same period. It would be useful to conduct further in-depth study of these incidents to gain further insight into the causes behind these accidents, to report on financial loss, and other related factors.

Figure 4. Heavy Fire Apparatus Crashes reported to ICBC, by Greater Vancouver Region: 2008 to 2012

Greater Vancouver	2008	2009	2010	2011	2012	Total					
			% change	% change	% change	% change					
Fire/Ladder Truck	49	n/a	44	-10.2%	37	-15.9%	36	-2.7%	31	-13.8%	197
Pumper	36	n/a	31	-14%	33	6.4%	29	-12.1%	32	10.3%	161
Commercial Total	126	125	-0.8%	107	-14.3%	101	-5.6%	91	-9.9%	550	

Figure 4 indicates a steady decline in the number of fire/ladder truck crashes from 2008 to 2012 in the Greater Vancouver area, with a mean of 39 (n=197). By 2010, crashes in this heavy vehicle category continued to dip below the 5-year mean. In total, fire/ladder truck crashes in Greater Vancouver accounted for 35.8 per cent of the total 550 reported accidents in the commercial vehicle category, which includes ambulance, police, and fire service vehicles. (Of note, this figure is derived from all crashes coded in the severity table, from single-vehicle accidents to multi-vehicle incidents, as well as crashes that led to injury and property damage). When examining yearly percentages of fire truck accidents from 2008 to 2012, and aside from a high of 38.8 percent in 2008, fire/ladder truck crashes had consistently accounted for slightly over a third of all reported accidents in the commercial vehicle category. Isolating fire/ladder truck crashes in the Greater Vancouver for further analysis yields several findings which underscore the continued decline of emergency vehicle accidents in the heavy fire truck category, notably fire/ladder trucks.

Figure 5. Linear Regression of Fire/Ladder Truck Crashes reported to ICBC, by Greater Vancouver Region: 2008 to 2012



Linear regression is a form of regression analysis in which observational data are modelled by a least squares function which is a linear combination of the model parameters and depends on one or

more independent variables. In linear regression the model function represents a straight line in a scatterplot. The results of the data fitting are subject to the following statistical analysis. A linear regression of fire/ladder truck crashes indicate a statistically-significant decline, an R^2 0.9622 with a line of best fit. All other things being equal or held constant, it is extrapolated that 13 fire/ladder truck crashes will occur in 2018.

Conclusions

In conclusion, with respect to the three main research questions, the following can be summarized:

1. There has been a steady decrease in the frequency of emergency vehicle crashes from 2008 to 2012 in BC, and occurrences of fire apparatus crashes are expected to continue to decline.
2. There has been a decrease in the severity emergency vehicle crashes in the province of BC, with BCAS ambulance incidents being low compared to fire service vehicles.
3. Crashes of fire service vehicles, in particular fire/ladder trucks, are predicted to decrease in the foreseeable future, specifically in the Greater Vancouver region.

Accidents involving emergency vehicles in BC are infrequent; most are of a minor nature and incur property damage only. In regards to certain types of emergency vehicles such as fire/ladder trucks operating in Greater Vancouver, it should be noted that such crashes are extremely rare.

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Appendix – Notes provided from the original data

1. Data include crashes in parking lots and crashes involving parked vehicles.
2. The vehicle may not be responding to an emergency at the time of the crash.
3. Emergency vehicles include: vehicles:
 - a) rate classes: 040, 041, 140, 141 and may include additional body styles other than emergency
 - b) a motor vehicle carrying rescue or first aid equipment where there is an urgent emergency justifying a rate of speed in excess of any maximum rate of speed provided for in the *Motor Vehicle Act*,
 - c) a motor vehicle driven by a member of a fire department in the discharge of his/her duties,
 - d) a motor vehicle driven by a peace officer, constable or member of the police branch of Her Majesty's Armed Forces in the discharge of his/her duty, or
 - e) an ambulance operated by the British Columbia Ambulance Services.
4. Passenger vehicles include body styles (2-door station wagons, 4-door station wagons, 4-door sedans and dual purpose vehicles).
5. Severity (Casualty) = Crash incident resulting in an injury or fatality.
6. Severity (Property Damage Only) = Crashes resulting in material damage only; no injuries or fatalities.