Vision Zero on Federal Level in Canada

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Contents

Abstract

This chapter will provide a summary of high-level details regarding Vision Zero implementation in Canada, looking specifically at research, strategies, and implementation experiences in British Columbia, Edmonton, Calgary, and Fort Saskatchewan in Alberta, Toronto in Ontario, and Montreal in Quebec. This chapter

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will speak to the differences between Vision Zero implementation in Canada compared with Sweden, considering the viewpoint and circumstances of the unique governmental structure in Canada and implementation in municipalities versus entire provinces or territories. Priorities for the future of Vision Zero will also be discussed, along with the intersections and role of public health and other applications of Vision Zero.

Keywords

Vision Zero · Road Safety · Road Injury · Collisions · Active Transportation · Countermeasures · Speed · Distracted Driving · Impaired Driving · Aggressive Driving · Enforcement · British Columbia · Edmonton · Calgary · Fort Saskatchewan · Alberta · Ontario · Quebec · Montreal · Toronto · Sweden · Canada

Introduction

Canada is the second-largest country in terms of land mass in the world, with a land area of 9,093,507 km^2 and a population of 36.9 million (Canada Facts n.d.). The governmental structure in Canada creates a unique environment for road safety and road safety countermeasures, with federal, provincial or territorial, and municipal governments, First Nations governments, and other organizations and police forces each having a say in legislation, budgeting, and enforcement related to road safety. Adopting Vision Zero takes a sense of urgency in combination with time, patience, and collaboration to be successful, and means making a public commitment to road safety, setting targets, and allocating resources. Numerous cities and provinces of various sizes across Canada, both rural and urban, have been inspired by the success of Vision Zero in Sweden and numerous other countries around the globe. Seeing what can be achieved has driven road safety advocates from multiple fields and jurisdictions across Canada to get involved in conducting research on road safety and adopting Vision Zero.

Overview of Canada

With a wide range of geographical and weather differences, along with a unique jurisdictional framework, many facets can impact road safety. Canada has three ocean borders: the Pacific Ocean in the west, the Atlantic Ocean in the east, and the Arctic Ocean to the north (Government of Canada 2017a). Canada borders the United States in the south and in the northwest and has many different types of landscape, including: high mountains, the foothills, prairie grasslands, different types of forests, and the Arctic tundra, where the ground is permanently frozen (Government of Canada 2017a).

Picture source: Canada Facts (n.d.)

In Canada, there are four seasons: winter, spring, summer, and autumn. Winter is cold in most places, with temperatures often below zero degrees Celsius. Snow covers the ground from around December to March or April each year. In Southwest British Columbia (around Victoria and Vancouver), many winters have no snow at all but only rain (Government of Canada 2017a). Summer lasts from around June to September and the weather varies from warm to hot. Daytime temperatures are generally between 20 and 30 degrees Celsius or Centigrade (68 and 86 degrees Fahrenheit), or higher. In southern Ontario and Quebec, it can often be very humid (Government of Canada 2017a). Finally, fall and spring are transition seasons, meaning the weather starts getting colder or warmer, and there is a lot of rain (Government of Canada 2017a).

Federal, Provincial, or Territorial Structure

Ottawa is the capital city of Canada and is located on the Ottawa River between Ontario and Quebec. Canada has ten provinces and three territories, each with its own capital city. These provinces and territories are grouped into five regions: the Atlantic Provinces (Newfoundland and Labrador, Prince Edward Island, Nova

Scotia, New Brunswick); Central Canada (Quebec and Ontario); the Prairie Provinces (Manitoba, Saskatchewan, Alberta); West Coast (British Columbia); and North (Nunavut, Northwest Territories, Yukon Territory) (Government of Canada 2017a). Most people live in southern Ontario and Quebec, Southwest British Columbia, and Alberta. Much of the north has a very low population because of the cold climate.

Government Structures

Canada has three main levels of government: federal, provincial or territorial, and municipal and First Nations. The federal government is based in Ottawa, Ontario, which handles both national and international matters (Government of Canada 2017b). Provincial and territorial governments are the next level in each province and territory in Canada. Finally, there are municipal and First Nations governments.

The provincial and territorial governments have the power to change their laws and manage their own public lands. They are in charge of education, health care, and road regulations (Government of Canada 2017b). Further, municipal governments run cities, towns, or districts. They are in charge of parks, parking, libraries, roadways, local police, local land use, fire protection, public transportation, and community water systems (Government of Canada 2017b). Across the country, band councils govern First Nations communities. Band members elect the band council, which make decisions that affect their local community (Government of Canada 2017b).

Road Safety Efforts Leading up to Vision Zero in Canada

While the introduction of the Vision Zero approach was an impactful step for road safety in Canada, Canada's road safety work began long before Vision Zero was first introduced. Given the plateau in road safety progress in the mid-1990s in Canada and the desire for improved cooperation among Canada's road safety stakeholders, experts from various levels of government, nongovernmental organizations, and other key stakeholders participated in a national forum on road safety. The forum led to the creation of Canada's first national road safety plan, called *Road Safety Vision (RSV) 2001*, in 1996 (Canadian Council of Motor Transport Administrators 2013). Canada was one of the first countries to implement a national road safety strategy, and since the introduction of the *RSV 2001,* three national strategies have been adopted (Canadian Council of Motor Transport Administrators 2016). During *RSV 2001*, Canada saw a 10% decrease in fatalities and a 16% decrease in serious injuries, despite an increase in road user population (Canadian Council of Motor Transport Administrators 2016).

The second strategy, *RSV 2010* was approved by the Council of Ministers in 2001. The vision and strategic objectives were based on *RSV 2001* and included a

national target and sub-targets. The targets provided road safety stakeholders with key road safety indicators to measure the impact of intervention efforts (Canadian Council of Motor Transport Administrators 2016). The national target was a 30% decrease in the average number of road users killed and seriously injured from 2008 to 2010 compared to 1996–2001, with an aim to reduce Canada's road fatality total to less than 2,100 by 2010 through achievement of the sub-targets (Canadian Council of Motor Transport Administrators 2016). While the 30% reduction in fatalities and serious injuries was not met by 2010, it was achieved in 2011 (Canadian Council of Motor Transport Administrators 2016).

In 2011, *Road Safety Strategy (RSS) 2015* was introduced. *RSS 2015* moved away from numerical targets, approaching road safety in a new, holistic way, and introducing the safer systems concept to tackle road user, vehicle, and road infrastructure issues (Canadian Council of Motor Transport Administrators 2016). This strategy introduced a framework of best practices, consisting of a multicell matrix of key risk groups and contributing factors, and an inventory of road safety initiatives that could be adopted to address priorities (Canadian Council of Motor Transport Administrators 2016). Jurisdictions were encouraged to develop their own road safety plans to meet their individual needs and adopt interventions to reduce fatalities and serious injuries (Canadian Council of Motor Transport Administrators 2016). In 2013, the number of fatalities and serious injuries on Canada's roads decreased by 21% compared to the 2006–2010 period (Canadian Council of Motor Transport Administrators 2016).

Finally, *Road Safety Strategy (RSS) 2025* is focused on the ambitious vision of "Toward Zero," and is based on the Vision Zero approach in Sweden and adopting the Safe Systems Approach to road safety (Canadian Council of Motor Transport Administrators 2016). Canada's Vision Zero approach can be characterized by the focus on helping and encouraging individual jurisdictions to implement road safety programs that meet their own needs, focused on the Safe Systems Approach and with an aspiration to achieve downward trends in fatalities and serious injuries on Canada's roads (Canadian Council of Motor Transport Administrators 2016).

Overview of Vision Zero in Canada

Vision Zero efforts in Canada began in a number of places including Edmonton, Alberta in 2015, and have continued to spread across the country since. Vision Zero has been adopted at the local or municipal level, such as in the City of Toronto, Ontario in 2016, to the provincial level, such as across the Province of British Columbia in 2016, and finally, at the national level, with the Road Safety Strategy 2025 also being developed in 2016. Several cities and regions, both rural and urban, continue to adopt Vision Zero in their jurisdictions.

Each level of government in Canada maintains unique road safety responsibilities; thus, when implementing Vision Zero in Canada, it is important to understand the governmental jurisdictional responsibilities and address each one, taking a collaborative approach to Vision Zero and road safety as a whole. This collaboration is exemplified through Canada's national road safety approach, which formally adopts

Vision Zero in principle. The Canadian Council of Motor Transport Administrators (CCMTA) developed Canada's Road Safety Strategy 2025 in 2016. The CCMTA is composed of representatives from all levels of the Canadian government, from the smaller-scale municipal level to the provincial, and finally the federal level. Each level contributes to the development of different road safety countermeasures.

To provide an example, standards for vehicle manufacturing are solely a federal responsibility, whereas built roadway design, maintenance, and re-design are shared among provincial or territorial, municipal, and First Nations governments. Further, while traffic laws are developed by federal, provincial/territorial, and municipal governments, they can be enforced by police at any level, such as the Ontario Provincial Police (OPP) at the provincial level, First Nations police, and the Royal Canadian Mounted Police (RCMP) at the national level (Government of Ontario 2019). Each level of government has a role to play in road safety in Canada and in the adoption of Vision Zero.

Vision Zero National/Federal

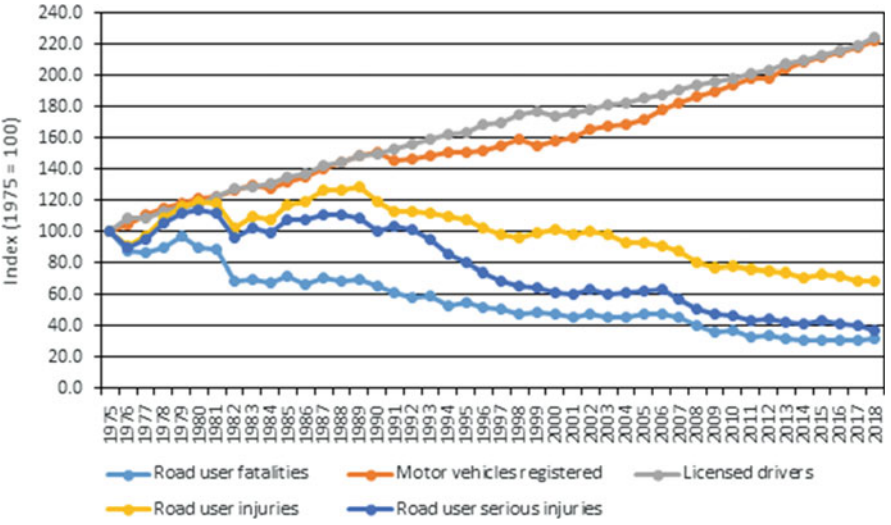
Transport Canada

Transport Canada is committed to keeping Canadian road users safe. As a federal regulator, the department updates vehicle safety regulations, standards and requirements for passenger vehicles, commercial vehicles, tires, and child car seats in Canada. The department plays an active role in crash test research and conducts tests on vehicle control technology and safety systems. Transport Canada is a leader in vehicle-defect reporting and investigations, and maintains the motor vehicle safety recalls database – the largest of its kind in Canada. The department also fosters innovation through its support, testing, and funding of projects related to automated vehicles, connected vehicles, and vehicle cybersecurity.

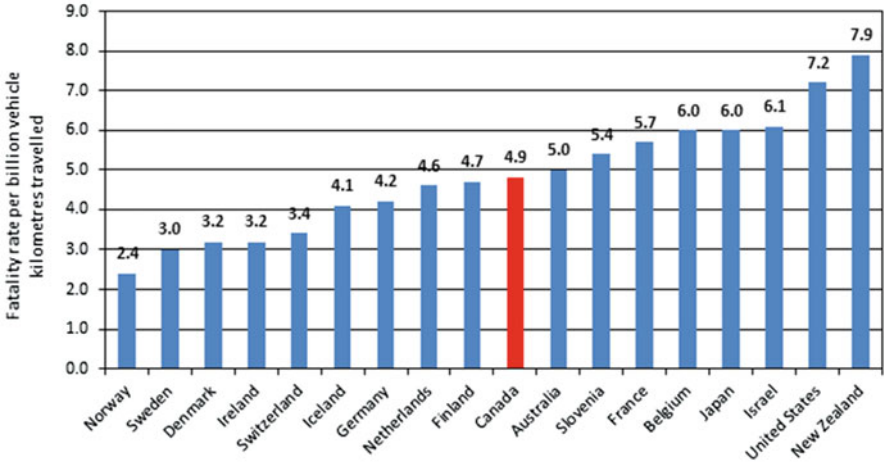
To advance a cohesive, national approach to road safety, Transport Canada works closely with the provinces and territories through the CCMTA on a range of national road safety issues, including commercial motor vehicle safety and vulnerable road users safety. Similarly, Transport Canada also works closely with the Transportation Association of Canada (TAC) to advance collaboration on safe road and highway infrastructure.

Overall Level of Road Safety

Over the last several decades, there has been a significant downward trend in motor vehicle casualties. Fatalities have decreased by almost 68%, while serious injuries have declined by 62% (Transport Canada, National Collision Database 2017). This notable progress was achieved despite significant growth in Canada's population, number of licensed drivers (+122%), number of registered vehicles (+124%), and vehicle kilometers travelled (Transport Canada as compiled from information provided by provinces and territories; Statistics Canada 2020).



In 2017, Canada was ranked 10th in terms of fatalities per billion vehicle kilometers travelled compared to other member countries of the Organization for Economic Cooperation and Development (OECD) (OECD International Transport Forum 2019). Safer vehicles, road infrastructure, and road user behavior have contributed to this greater level of safety. Seat belt use, for example, has increased from about 20% in the 1970s to 97% in 2016–2017.



Despite this tremendous progress, there is still significant work to be done. Transport Canada is a strong supporter of the international Vision Zero initiative to advance road safety. Our work in support of Vision Zero is facilitated through Canada's own Road Safety Strategy 2025. The Strategy has been endorsed by all ministers responsible for transportation and highway safety at the federal and provincial/territorial

levels. An overview of key road safety issues and priority areas of Transport Canada's work in support of this strategy are discussed in further detail below.

Impaired Driving

Transport Canada continues to work collaboratively with provinces and territories through the CCMTA to address impaired driving. This includes assisting the provinces and territories in conducting roadside surveys to assess the number of drug-impaired drivers on the road. Through collaboration with the provinces and territories and partners from the road safety community, the percentage of fatalities involving a driver considered by police to be under the influence of alcohol has decreased from 21% in 2008 to 14% in 2017 (Transport Canada, National Collision Database 2017). Data also indicates that the percentage of Canadians that were fatally injured in road crashes involving a drinking driver has decreased from 34% in 2008 to 29% in 2016 (Lyon et al. 2019).

Further progress to address impaired driving will be supported by 2018 amendments to the Criminal Code of Canada (CCC). These amendments included new offenses related to driving under the influence of cannabis as well as new authorities for police to demand that any lawfully stopped driver provide a breath sample to test for alcohol.

Distracted Driving

Distracted driving is a serious safety concern for all Canadians. To address this challenge, all levels of government are working together through the CCMTA to implement an action plan on distracted driving. Key initiatives include: creating nationally consistent penalty regimes; supporting the development and refinement of data sources; and developing a best practice model for addressing distracted driving, including legislative measures, enforcement tools, and techniques to assist police.

As part of this action plan, the department worked closely with the CCMTA and the provinces and territories to develop a report on distracted driving, which includes best practices for addressing this issue. Published in December 2018, the report is available at https://ccmta.ca/en/ccmta-s-distracted-driving-white-paper-now-available.

Transport Canada also encourages vehicle and electronics manufacturers to design devices that are compatible with safe driving. In February 2019, the department published the Guidelines to Limit Distractions from Visual Displays in Vehicles, which can be found at http://www.tc.gc.ca/en/services/road/stay-safe-when-driving/guidelines-limit-distraction-visual-displays-vehicles.html.

Vulnerable Road Users (VRUs)

Transport Canada is taking action to better protect vulnerable road users, including pedestrians and cyclists. In October 2018, the Council of Ministers Responsible for Transportation and Highway Safety published its report Safety Measures for Cyclists and Pedestrians around Heavy Vehicles – Summary Report outlining 57 safety measures to better protect vulnerable road users. Further, in January 2019, the Council of Ministers approved next steps for the implementation of the report, with an emphasis on pilot projects, knowledge exchange, and reviewing safety standards and regulations. To build momentum in this area, Transport Canada has launched on-road field trials, in collaboration with municipal partners, to evaluate the effectiveness of a detection and visibility system on commercial vehicles.

Heavy Commercial Vehicles

Commercial motor vehicle safety is also a shared responsibility among federal, provincial and territorial governments, and owners/operators. Under the Motor Vehicle Safety Act, Transport Canada is responsible for establishing the Canada Motor Vehicle Safety Standards, which includes specific safety requirements for commercial motor vehicles, such as brake systems, stability control, tires, and lighting, among others. The Department works with all levels of government to keep these standards up-to-date, and performs tests to ensure compliance. Under the Motor Vehicle Transport Act, Transport Canada is also responsible for certain operational matters relating to commercial motor vehicle activity (e.g., hours of service and safety ratings).

Our collaborative work with provinces and territories through the CCMTA to strengthen commercial motor vehicle safety includes measures to prevent fatigue and distracted driving. For example, in June 2019, the department published a regulation mandating electronic logging devices (ELDs) for commercial carriers to reduce the risk of fatigue-related collisions. The work with the CCMTA also includes finalizing a national standard for entry-level training for commercial drivers. This standard represents an important milestone for road safety in Canada and will help ensure drivers have the necessary knowledge and skills to safely operate commercial vehicles.

While school buses are recognized as the safest way to transport school children in Canada, Transport Canada, together with provincial and territorial partners, recognizes that there are ways to make school buses even safer. To advance this important issue, on January 21, 2019, the federal, provincial, and territorial Council of Ministers Responsible for Transportation and Highway Safety established an expert Task Force on School Bus Safety, composed of the aforementioned governments, fleet operators, bus manufacturers, school boards, driver unions, and safety associations, to identify opportunities to further strengthen school bus safety. Specifically, the Task Force was mandated to review safety standards and operations, both inside and outside the school bus, with an emphasis on seat belts.

Automated and Connected Vehicles

Transport Canada has undertaken a number of initiatives to support the safe testing and deployment of connected and automated vehicle technologies, building on recommendations found in the January 2018 report Driving Change, prepared by the Senate Committee on Transport and Communications. Since the report's publication, Transport Canada has amended the Motor Vehicle Safety Act (MVSA - March 2018) to afford greater flexibility to keep pace with emerging technologies (e.g., modernized/new authorities to grant exemptions, take enforcement action, and modify or suspend outdated regulations).

In February 2019, the department also released Canada's Safety Framework for Automated and Connected Vehicles, which articulates the department's vision for the safety of these technologies. The Framework is supported by a number of guidance documents including the Safety Assessment for Automated Driving Systems in Canada, and Testing Highly Automated Vehicles in Canada: Guidelines for Trial Organizations. All of these documents as well as additional information on the Government of Canada's work to address automated driving systems can be found at: http://www.canada.ca/automatedvehicles.

Transport Canada is also conducting research into advanced driver assistance systems, which in many cases feature low-level automation features that can enhance the safety of road users. Transport Canada continues to explore ways to support consumer awareness of the safe use of these features, including publishing information at: https://www.tc.gc.ca/en/services/road.html.

Canadian Council of Motor Transport Administrators Road Safety Strategy 2025

The Canadian Council of Motor Transport Administrators (CCMTA) coordinates matters dealing with the administration, regulation and control of motor vehicle transportation, and highway safety. CCMTA members represent provincial, territorial, and federal governments and are committed to shared road safety goals in Canada. CCMTA works for Canadians by ensuring that government and road safety stakeholders have a national forum to come together and share knowledge on current and emerging road safety priorities that impact jurisdictional and national policy. This approach is built on the values of engagement and accountability, and respects jurisdictional autonomy to adopt or adapt specific programs as appropriate. Canada is one of the first countries in the world to adopt a national road safety strategy in 1996 and, to date, three national strategies have been launched (2001, 2010, and 2015). With the help of CCMTA's road safety programs, research, collaborative partnerships, and public education campaigns, Canada has seen continued downward trends in fatalities and serious injuries on roads despite more drivers, vehicles, and kilometers travelled since 2001(CCMTA 2016).

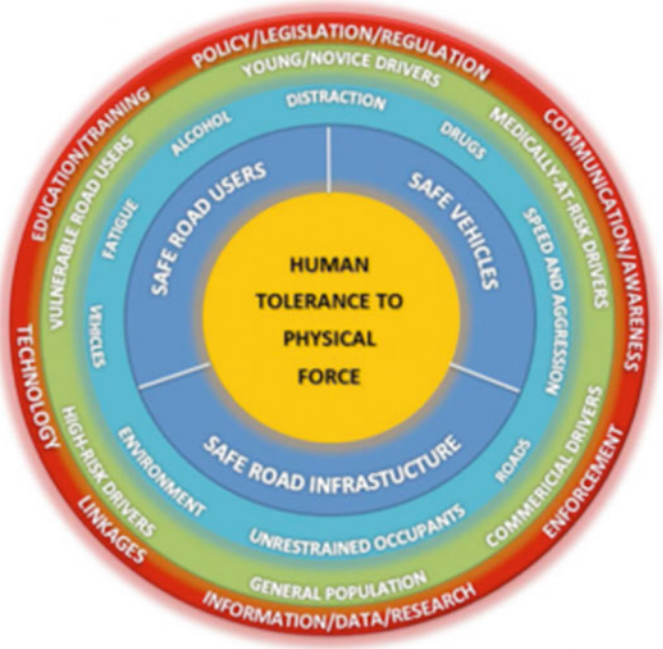
Road Safety Strategy 2025 is intended to continue to encourage road safety stakeholders from all levels of the government, as well as private sector, and non-governmental stakeholders, to collaborate in making Canada's roads the safest in the world and unite efforts to reach the long-term vision of zero fatalities and serious injuries on Canadian roads. It was developed with the intention of helping jurisdictions implement road safety programs that meet their own needs. Road Safety Strategy (RSS) 2025 is similar to its predecessors in a number of ways. It retains the long-term vision of making Canada's roads the safest in the world but combines this with the vision of **Toward Zero**. A number of principles key to the strategy's success have been aligned with international best practices in road safety. These principles include adopting the Safe System Approach, a 10-year timeline, and providing an inventory of proven and promising best practices to address key risk groups and contributing factors.

RSS 2025s vision, "Toward Zero – The safest roads in the world" is based on an international best practice first adopted by Sweden in 1997, where Vision Zero was approved by parliament and has permeated the country's approach to road safety ever since. It has resulted in Sweden having among the lowest traffic-related fatality rates worldwide and has led to other countries and municipal governments initiating similar approaches. Toward Zero is not a target to be achieved by a certain date; it is aspirational. This vision will continue beyond RSS 2025s timeline and highlights the desire for the best road safety outcomes for all Canadian jurisdictions.

The following strategic objectives form the cornerstone of RSS 2025 and focus on safer road users, road infrastructure, and vehicles: raising public awareness and

commitment to road safety; improving communication, cooperation, and collaboration among stakeholders; enhancing legislation and enforcement; improving road safety information in support of research and evaluation; improving the safety of vehicles and road infrastructure; and leveraging technology and innovation. Core to the strategy is an inventory of best-practice interventions used by leading road safety countries that have been effective in reducing fatalities and serious injuries.

RSS 2025 further lays out guiding principles to adopt a Safe System Approach. The Safe System Approach (SSA) is how many countries leading in road safety are achieving their vision of eliminating deaths and serious injuries. SSA contains the following principles: Ethics (human life and health are paramount and take priority over mobility and other objectives of the road traffic system and life and health can never be exchanged for other benefits within the society); Responsibility (providers and regulators of the road traffic system share responsibility with users); Safety (road traffic systems should take account of human fallibility and minimize both the opportunities for errors and the harm done when they occur); and mechanisms for change (providers and regulators must do their utmost to guarantee the safety of all citizens; they must cooperate with road users; and all three must be ready to change to achieve safety). It is recognized that Canadian jurisdictions will implement the SSA in a manner that is appropriate to their environments.



Source of picture: CCMTA version specifically developed for RSS 2025 adapted from the 2009 WHO report on the Global Status on Road Safety which was in turn modified from work commissioned by the Government of Western Australia.

RSS 2025 seeks to achieve directional downward trends in the rate-based number of fatalities and serious injuries rather than in the actual numbers of fatalities and serious injuries. These trends will be measured at the national level annually, using multi-year rolling averages to smooth out short-term fluctuations since year-over-year reductions may not be practical or attainable. In Canada, the rate-based indicators are fatalities and serious injuries per billion kilometers traveled and fatalities and serious injuries per one hundred thousand population. These rate-based indicators are commonly used internationally as well. Although RSS 2025 does not include hard quantitative targets, it does not preclude individual jurisdictions or organizations from establishing their own targets when there is government, law enforcement, and/or road safety stakeholder support for doing so.

Canadian Association of Road Safety Professionals: A Multidisciplinary Approach to Vision Zero

The Canadian Association of Road Safety Professionals (CARSP; CARSP.ca), founded in 1985, is a national organization dedicated to enhancing road safety at home and abroad. CARSP currently has a membership of 551 members (both individual and corporate). CARSP supports Canada's road safety community by providing access to multi-disciplinary information, research, and networking opportunities. CARSP is a diverse group of professionals involved in the research, management, delivery, and promotion of road safety programs, from a broad array of disciplines (from engineering to social science and health promotion) and employers (public, private, at the federal, provincial, and local levels). CARSP encourages the sharing of professional experience; facilitates communication and cooperation among road safety groups and agencies; promotes research and professional development; and provides an influential voice for road safety professionals to communicate knowledge-based advice to policymakers.

CARSP members belong to various disciplines: Government (Federal, provincial/territorial, or local); Police/enforcement (federal, provincial/territorial, and local); University/College (e.g., Engineering, Psychology, Epidemiology, and Health Sciences); nonprofit safety organizations (e.g., Safety Councils, Injury Prevention units, and Drinking and Driving Counterattack groups); private consultants (e.g., in Engineering, Planning, Geography, and Technology); research agencies (e.g., Traffic Injury Research Foundation, Canadian Centre on Substance Abuse), driving institutes, motor associations (e.g., Canadian Automobile Association), insurance organizations (e.g., Saskatchewan Government Insurance, Insurance Corporation of British Columbia, and Manitoba Public Insurance); and legal professionals.

CARSP's vision statement is: "Professionals collaborating in research and practice to make our roads the safest in the world." Vision Zero and other related statements with an ultimate goal of zero fatalities and serious injuries on public roads are consistent with CARSP's vision. CARSP's position is that statements of Vision Zero, while important, are unlikely to accelerate progress toward such a goal without quality data, rigorous evaluation, bold leadership, sustainable funding, and

significant changes in both the public and institutional culture. The expansion of dedicated facilities for vulnerable road users, the continuing shift from personal vehicle to public transit use, significant changes to land use planning and speed management and the evolution of vehicle automation are all critical toward achieving these goals.

To help spread knowledge about Vision Zero in Canada, CARSP has given it a strong emphasis in the planning of its activities. CARSP hosts an annual conference that attracts Canadian and international delegates. The conference features keynote speakers, panel discussions and paper sessions in both "Policy and Practice" and "Research and Evaluation" streams. Vision Zero topics have been included since 2015 and were the overall conference theme in 2019.

The 2019 conference included sessions on the Safe Systems Approach and city-wide road safety plans, distracted driving and crossing, vulnerable road user safety, speeding and risky driving, cycling safety, driver training and driver fitness, truck safety, pedestrian safety, autonomous vehicles, connected vehicles and networks, and advanced vehicle technology and built environment's relationship to road safety, to name a few. A special "fireside chat" panel session on Vision Zero was also held, in which themes such as the public health approach and the power of the media and the general public in Vision Zero were explored. A full-day workshop, "Vision Zero – Understanding and Action," was also held as part of the conference, which translated the principles of Vision Zero into decision and action using real-life examples.

CARSP regularly offers in-person workshops and webinar presentations on Vision Zero, delivered by a wide range of practitioners from across Canada and abroad. Its monthly publication, *Canadian Road Safety News Digest,* covers the latest news stories across the country related to Vision Zero; and a quarterly newsletter, *The Safety Network*, covers initiatives and research by road safety professionals on topics such as Vision Zero. Finally, in support of its vision to make Canadian roads the safest in the world, CARSP continues to coordinate with other national organizations – such as Parachute and the Transportation Association of Canada – to collaborate on areas of common interest related to Vision Zero. CARSP maintains the clear and persuasive position that only through a complete multi-disciplinary approach endorsed by organizations such as CARSP can the ultimate goal of zero be achieved.

Transportation Association of Canada: Road Safety and Vision Zero

The Transportation Association of Canada (TAC; www.tac-atc.ca) is a not-for-profit, national technical association that focuses on road and highway infrastructure and urban transportation. Its 500 corporate members include governments, businesses, academic institutions, and other associations. TAC provides a neutral, nonpartisan forum for those organizations, and their thousands of staff, to come together to share ideas and information, build knowledge and pool resources in addressing transportation issues and challenges.

TAC celebrated its centennial in 2014 and, with more than 100 years of history in the transportation sector, is continuing its important work to identify best practices and encourage harmonization of those practices across jurisdictions. While TAC does not set standards, it produces credible transportation planning, design, construction, management, operation, and maintenance guidelines that emphasize safety. Safety is one of six focus areas in TAC's strategic plan, which encourages efforts to address road safety through a combination of engineering, education, and enforcement, and by adopting Safe Systems Approaches to plan, design, and build infrastructure, and deliver transportation services. To that end, almost every TAC technical guideline offers means, directly or indirectly, to improve and ensure transportation safety.

TAC's volunteer councils and committees share knowledge, exchange information, and discuss a wide variety of issues to advance the state of transportation. The Road Safety Standing Committee (RSSC), formed in 2000, is concerned with raising awareness of road safety issues among TAC members; identifying and prioritizing road safety issues; promoting safety-conscious, knowledge-based approaches; emphasizing the need for dedicated roadway safety staff at all levels of government; and providing road safety training for transportation professionals.

For several years, the RSSC has endorsed the Safe Systems Approach, with engineering as a critical component. Since 2015, the RSSC has discussed Vision Zero and organized several conference sessions, workshops, and webinars related to the development of road safety plans. In its newly adopted strategic plan, the RSSC commits to be a catalyst for Vision Zero and Safe Systems Approaches. This direction is supported by three initiatives: (1) Create a Vision Zero and Safe Systems Subcommittee; (2) Conduct a constructive review of TAC publications with respect to safe systems concepts; and (3) Enable Vision Zero and safe systems knowledge exchange.

TAC has spent several years developing a series of publications on road safety for Canadian practitioners and is now planning future enhancements to consolidate this knowledge into a comprehensive guide. Finally, road safety will also be the theme of TAC's 2020 Conference and Exhibition in Vancouver, British Columbia. Through these and other endeavors, TAC and its RSSC will continue to support research and development, knowledge transfer, and the development of guidelines in support of Vision Zero and Safe Systems principles.

Traffic Injury Research Foundation: Strategies to Support Vision Zero in Canada

The Traffic Injury Research Foundation (TIRF; www.tirf.ca) is one of Canada's road safety research institutes and a world leader in research, program and policy development, evaluation, and knowledge transfer. Established as a registered charity, TIRF studies the human causes and effects of road crashes. Its focus is on people on the roads and behaviors that result in driver error and account for more than 90% of road crashes.

For more than four decades, TIRF has maintained a National Fatality Database to enhance understanding about why road users behave as they do. These data have been the foundation for the development and implementation of solutions aimed at addressing underlying causal factors. TIRF's work has evaluated a broad spectrum of road safety policies and programs and helped stakeholders identify effective solutions. Its research has been widely shared to inform decisions and action by government, business and industry, traffic safety agencies, and nonprofit organizations in many countries. Findings published by TIRF have contributed to crash reductions and improved safety for all Canadians by creating and sharing knowledge about current and emerging issues and trends that place road users at risk.

Most importantly, TIRF has developed its own knowledge transfer model using a "Systems Approach" to promote shared understanding of issues with a focus on implementation. This has enabled TIRF to bridge gaps and build partnerships among agencies and practitioners across the many sectors affected by road crashes. Collectively, these activities are important to help support Vision Zero initiatives at all levels in Canada. As jurisdictions increasingly adopt strategies to achieve zero deaths, research and best practices are essential to guide the development of programs and policies, just as evaluation research is vital to determine if investments in countermeasures are wise and will produce a return on investment in the form of fewer deaths and injuries. Of equal importance, communities need tools to help them use research as they embark on the pursuit of road safety strategies. Today, many communities are better informed about what needs to be done to make roads safer, but they struggle with how to do it.

To fill this gap, in 2017 TIRF turned its attention to creating knowledge and a series of tools to help communities do just that. TIRF, in partnership with Desjardins, used its knowledge and expertise gained over five decades to design a web-based suite of road safety resources, the Action2Zero Centre. The objective of this Center was to help communities use research to guide the development and implementation of strategic road safety plans based on Vision Zero and Safe System philosophies. In particular, the Center can enable communities to raise awareness and build capacity for effective road safety initiatives, to monitor and measure program outcomes and improvements in road safety, and to support the work of local governments and their road safety partners.

A key feature of the Center is an automated, online tool that communities can use to assess the status of road safety in their community across several domains, such as speed management, infrastructure for vulnerable road users, distracted driving, and leadership. The assessment tool developed by TIRF uses a set of road safety criteria for a five-star community based on international research and best practices. This five-star community approach is in line with other areas of safety that describe five-star ratings for roads (e.g., International Road Assessment Program or IRAP) and vehicles (e.g., five-star safety ratings for vehicles used by the National Highway Traffic Safety Administration or NHTSA, and the Insurance Institute for Highway Safety or IIHS). As such, the assessment tool helps communities track progress toward five-star status.

The Center meets the needs of a wide spectrum of road safety stakeholders including local government, public health, law enforcement, schools, community-based organizations, engineers, and city planners. The online tool enables communities to identify which measures have been implemented and areas where greater efforts are required. Ultimately, outcomes of the tool provide a clear picture of potential components of a strategic plan and suggest the types of knowledge, expertise, and resources needed to achieve further reductions in road deaths and injuries.

It is structured in several stepwise modules to help communities build support, buy-in, and partnerships for the implementation of plans to accelerate action and improve road safety outcomes. A suite of templates and tools, links to relevant research, and best practices are contained within the Center to share experiences from other jurisdictions and help communities implement a variety of road safety strategies, such as creating effective road safety campaigns, improving safety in school zones and reducing speeds in residential areas. It also provides guidance on approaches to engaging stakeholders, building partnerships and communities of practice, and organizing committees for specific tasks. This initiative is being piloted in three jurisdictions in Canada and will launch in 2019 at act2zero.tirf.ca.

Parachute: Vision Zero Network

Parachute is Canada's leading national charity dedicated to injury prevention, with a vision of a Canada free of serious injuries, with Canadians living long lives to the fullest. Parachute Vision Zero works to share current research and best practices in road safety, support data-driven models, create and disseminate evidence-based resources, and bridge key multisector players together to increase the overall awareness and effectiveness of the Vision Zero approach. By building awareness of Vision Zero, Parachute also builds capacity for more jurisdictions across Canada to integrate a Vision Zero approach. At an individual level, implementing the Vision Zero approach in communities will ultimately lead to a shift in thinking about motor vehicle collisions, moving away from the belief that these are *accidents* and toward the understanding that collisions are predictable and preventable.

Parachute Vision Zero provides case studies and infographics on important road safety topics, such as safe school zones, cannabis- and drug-impaired driving, collision avoidance systems in vehicles, and data-driven approaches, alongside summaries of Vision Zero implementation experiences across Canada, including videos and interviews with key stakeholders. Further, Parachute Vision Zero gathers Vision Zero resources worldwide and has also created several of its own resources and tools to help communities move from thinking about Vision Zero to adopting and implementing this road safety approach successfully.

Parachute, with support from Desjardins, created the Parachute Vision Zero Network to bring together road safety experts and advocates across Canada. Parachute acts as a facilitator to create positive change by bringing network members

together to exchange information and ideas, and to work together to improve safety on Canada's roads. The Network continues to grow, with more than 335 members as of October 2019.

Parachute has remained active as a leader in Vision Zero in Canada, participating in panel discussions, holding events such as summits for Parachute Vision Zero Network members, and speaking at major conferences, such as the CARSP conference in Calgary, Alberta in May 2019. In 2017, Parachute held a two-day conference for Vision Zero Network members, bringing together grassroots organizations, enforcement, public health professionals, and researchers to discuss the implementation of Vision Zero in Canada. In 2019, Parachute's President and CEO, was a keynote speaker at the CARSP Conference, delivering a presentation on Vision Zero in Canada. Parachute was also active in panel discussions and a post-conference workshop at the CARSP conference.

Health Canada Substance Use and Addictions Program (SUAP) provided funding to Parachute for a three-year project entitled *#KnowWhatImpairedMeans*. The project looks at drug-impaired driving in Canada, particularly among Canadians between 15 and 24 years of age. As cannabis became a legal drug in Canada in 2018, Parachute launched a small-scale #KnowWhatImpairedMeans campaign to point out that, while cannabis was now legal, it is still illegal to drive high and can have a negative effect on a person's reaction time and focus. The national #KnowWhatImpairedMeans campaign launched in fall 2019 and was designed to raise awareness around the dangers of drug-impaired driving, in a way that resonates with online youth audiences. Messaging is informed by the population of interest, is evidence-based, and focuses on why cannabis impairs one's ability to operate a motor vehicle safely. Learn more about the #KnowWhatImpairedMeans campaign at parachute.ca/knowwhatimpairedmeans.

Canadian Research Related to Vision Zero

There is a significant volume of road safety research taking place in provinces across Canada. These research studies cover a number of key topic areas, including: active transportation and safe school zones, impaired driving, road safety countermeasures (technology and infrastructure), and vulnerable road users (cyclists, pedestrians, and older adults), to name just a few.

Active Transportation and Safe School Zones

Active transportation refers to any human-powered form of travel, such as cycling, walking, and skateboarding. Often, research may look at active transportation and safe school zones in combination, given the overlap in the subject areas and the need for children to be able to travel to and from school safely, regardless of their mode of transportation. Safe school zones often include measures such as traffic calming, built environment changes, and enforcement. Some Canadian research studies in these areas include:

- *Alberta*
  - *Child Active-transportation Safety and the Environment* (CHASE), Hagel et al.
  - *Before and After Evaluation of School Zones*, El-Basyouny.
- *Ontario*
  - *Effectiveness of Built Environment Interventions Around Schools in Improving Road Safety and Increasing Active School Transportation*, Rothman et al.
- *Quebec*
  - *Children and social interaction outside school: what are the roles of transport and information and communication technologies (ICTs)?*, Owen Waygood.

Impaired Driving

With the legalization of cannabis in Canada and continuous monitoring of drinking and driving regulations, there is a need for research on different influences, environments, and interventions around impaired driving. Impaired driving research studies in Canada are looking at the effects of driving under the influence of drugs (including cannabis), alcohol, and prescription medications. Canadian research in this area includes:

- *British Columbia*
  - *Monitoring and Preventing Drug-Impaired Driving in Canada*, Brubacher et al.
  - *Prescription Medications and the Risk of Motor Vehicle Crashes,* Brubacher et al.
  - *Evaluation of the Effect of Cannabis Legalization on Road Safety*, Brubacher et al.
  - *Cannabis and Motor Vehicle Crashes: A Multicentre Culpability Study,* Brubacher et al.
- *Quebec*
  - *Team in Transdisciplinary Studies on Driving While Intoxicated at the Douglas Research Centre, McGill University,* Marie Claude Ouimet and Thomas Brown.

Road Safety Countermeasures

Road safety countermeasures are steps that are taken to improve road safety for all road users. Road safety countermeasures can include technology advancements, such as driver feedback signs, photo enforcement, and red light cameras, built environment changes such as roundabouts, cycling lanes, and intersection improvements, or policy changes such as speed limit reductions. Some Canadian research in this area includes:

- *Alberta*
  - *A Safety Assessment of Driver Feedback Signs* (DFS) *and Development of Future Expansion Program*, El-Basyouny and Kwon.

  - *Deployment Strategies for the City of Edmonton's Mobile Photo Enforcement* (MPE) *Program,* El-Basyouny and Kim.
  - *Before and After Evaluation of Intersection Safety Devices* (ISD) *Evaluation,* El-Basyouny.
- *British Columbia*
  - *Evaluation of Traffic Safety Interventions in British Columbia, Brubacher et al.*
  - *Evaluation of Speed Limit Changes in British Columbia, Brubacher et al.*

Vulnerable Road Users (VRU)

Vulnerable road users (VRU) are unprotected against the speed and mass of vehicles on our roadways and thus tend to suffer more severe consequences in collisions (European Road Safety Observatory 2018). Studies in this area cover VRUs such as cyclists, pedestrians, and older drivers, considering factors such as the influence of the built environment on VRU crashes. Canadian research in this area includes:

- *British Columbia*
  - *Bicyclists' Injuries and the Cycling Environment (BICE) study*, Teschke et al.
- *Quebec*
  - *CHASE project: Child Active Transportation Safety and the Environment, Marie-Soleil Cloutier.*
  - *Pilot project on the road safety of all-way stops intersections using surrogate safety methods, Luis Miranda-Moreno.*

Another major trend in research on driving behavior and mobility is related to the growing older adult population. Older adults often require monitoring of their driving through education, evaluation, and intervention, and help to cope with the eventual end of their driving "career" in certain cases. Canadian research in this area includes:

- *Quebec*
  - *Impact of two functional capacity training programs on the ability to drive of older drivers*, Martin Lavallière.
  - *To drive or not to drive? Understanding the influence of the complex relationships between personal and environmental factors on the driving mobility of older Canadians,* Mélanie Levasseur.

This is not a comprehensive list of research being conducted in Canada related to Vision Zero. Dr. Karim El-Basyouny's study, *Assessing the Safety Effects of Achieving Bare-Pavement Road Conditions for Winter Maintenance* and Dr. Jeff Brubacher's study, *Predictors of Poor Health and Functional Recovery Following Road Trauma: An Emergency Department Inception Cohort Study.*

Vision Zero Implementation

British Columbia

Background

British Columbia (B.C.) is home to more than five million residents, ranking as the third-highest populated province in Canada (Government of British Columbia 2019; Statistics Canada 2019). With a long history of natural resource use, B.C. hosts a large, unpaved road network – covering 66% of the entire province's land base. There are precisely 57,100 km of paved roads in comparison to the massive 662,000 km of unpaved roads (Environmental Reporting BC 2018). Although there is a smaller paved road network compared to land mass, safe roadways and systems are critical to the residents, businesses, and visitors who travel the vast province using multiple modes of transportation each day. On average, B.C. receives nearly 20 million visitors each year, with more than seven million visitors using key highways throughout the province (Destination British Columbia 2019).

The province has a diverse and lush natural landscape, with rapidly changing weather and climate conditions, which can create a unique challenge when analyzing roadways and infrastructure. In addition, B.C. is located along Canada's Pacific Gateway, moving people and goods between North America and the world through marine ports, railways, roads, and airports to provide efficient and reliable market access.

In Vancouver, the province's largest city, there is a higher percentage of residents walking or cycling to work than any other major city in Canada (City of Vancouver 2017). Fifty-two percent of residents drive, 16% travel by transit, 25% walk, and 7% cycle (City of Vancouver 2017). Fifty-five percent of fatal collisions on Vancouver roads in 2017 involved pedestrians, cyclists, or skateboarders (City of Vancouver 2019). In Surrey, a major city in British Columbia, 81% of residents drive, 15% travel by transit, 3% walk, 1% travel via motorcycle, and 0.4% cycle (City of Surrey n.d.). In Vancouver, 55% of fatal collisions in 2017 involved pedestrians, cyclists, or skateboarders (City of Vancouver 2019). On Surrey roads, a pedestrian is 42 times more likely to die in a collision than a person driving a motor vehicle (City of Surrey n.d.).

Vision Zero in British Columbia

In 2016, B.C. became the first Canadian province to adopt Vision Zero. After success with *British Columbia Road Safety Strategy 2015*, the province released an updated report: *Moving to Vision Zero: Road Safety Strategy Update and Showcase of Innovation in British Columbia*, aligning with Canada's Road Safety Strategy and officially adopting Vision Zero (RoadSafetyBC 2016). B.C.'s approach to Vision Zero focuses on the four pillars of the Safe Systems Approach: safe road users, safe vehicles, safe roadways, and safe speeds, and incorporates evidence-based practices and in-depth study into how road safety is managed across the province.

B.C. uses 10-year collision data from police reports to monitor the effectiveness of their Vision Zero initiatives. The reports consider fatalities, serious injuries,

injuries, as well as the contributing factors for the collision(s) (RoadSafetyBC 2018). Factors include speeding, distracted driving, impairment and aggressive driving, driver error, and environmental factors. The most recent report (2008–2017) states speeding and impairment were the contributing factors that had the highest rate of fatal victims per police-reported crash. However, the most common factors for collisions can be attributed to distracted driving and aggressive driving.

Countermeasures

Collaborative Projects

The Ministry of Transportation and Infrastructure recently released its new active transportation strategy – *Move. Commute. Connect.* – designed to encourage active transportation use with a variety of incentives and work with communities to create policies and plans that support complete active transportation networks around the province (CleanBC 2019). This strategy includes a focus on safety and integrating transportation and infrastructure planning to ensure that projects such as new bridges and interchanges are designed to make walking, cycling, and transit safe and convenient for everyone. As part of this work, the Ministry released the B.C. Active Transportation Design Guide in June 2019, which is available free of charge to anyone in the world.

Further, led collaboratively by a Steering Committee of Senior Level Officials, and a cross-section of partners from across the Province, the B.C. Road Safety Strategy (BCRSS) aligns Vision Zero with the strategic direction for five working committees, each with a diverse group of experts in their fields, collaborating on road safety issues. The BCRSS Working Committees meet on a regular basis to identify issues and priorities, propose solutions, provide their diverse expertise and perspectives, and support the implementation of various initiatives.

Most recently, as part of the BCRSS, RoadSafetyBC released the B.C. Community Road Safety Toolkit to provide information for local governments on proven road safety best practices, including those that can improve safety for vulnerable road users, such as cyclists and pedestrians (Government of British Columbia n.d.-a). In addition to the development of the toolkit, the organization met with hundreds of local government representatives at their annual regional meetings, along with partners from the Insurance Corporation of British Columbia (ICBC), to talk directly to the communities about their unique road safety concerns.

The Ministry of Transportation and Infrastructure and the ICBC work on the Community Safety Enhancement Program and Road Safety Partnership, with the goal to address and improve local road safety priorities – based on community safety and requirements. The programs are driven by community input and could include roadside delineation, dedicated left-turn signals, improved pedestrian crosswalks, and additional traffic signals.

Enforcement

B.C has advanced its enforcement techniques and tools over the past few years through several initiatives and projects. Some of the key areas are listed below, in

addition to established and new programs, such as the Counterattack Drinking and Driving Campaigns, an Automated License Plate Program, and targeting prolific prohibited drivers.

The province has improved its legislation and policies to combat unsafe and high-risk driver behaviors. In 2010, B.C. introduced a comprehensive new law for distracted driving (electronic devices) and since that time the penalties associated with these offenses have been increased on two separate occasions. B.C. increased the fines and penalty points for anyone caught talking, texting, or emailing on a phone while driving. Using an electronic device while driving has now been classified as a high-risk offense, leading to mandatory driver improvement training. Currently, anyone with two distracted driving tickets in a three-year period will see their total financial penalties rise to as much as $2,000.

Additionally, the B.C. Government, police, and ICBC conduct two distracted driving education and enhanced enforcement campaigns each year, which also include advertising and social media support. Further, ICBC is also looking to use telematics to determine whether using this technology can improve road safety and driving behavior for inexperienced drivers.

Between 2012 and 2016, Intersection Safety Camera (ISC) sites in B.C. reported an average of 10,500 vehicles a year going at least 30 km/h over the posted speed limit, as detected by red-light cameras, which also monitor vehicle speeds. Speed has been one of the top contributing factors in casualty crashes at these intersections, which have had a combined total of more than 11,500 collisions per year. Speed cameras were activated in summer 2019 (Government of British Columbia n.d.-b). B.C. has recently activated new technology to ticket the registered owners of vehicles speeding through these intersections well over the posted limit on a red, yellow, or green light. New signs warn approaching drivers about the enhanced intersection speed enforcement.

Further, in summer 2019, the Ministry of Transportation and Infrastructure, in partnership with ICBC, applied High Friction Surface Treatment to 14 locations to reduce the frequency of rear-end collisions at key intersections and ramps. The treatments improve friction, allowing drivers to stop more quickly, reducing both the severity and number of collisions from occurring.

In 2018, B.C. with partner support from Mothers Against Drunk Driving (MADD) and Transport Canada, also conducted its eighth Roadside Survey. The survey measured the prevalence of alcohol and drug-affected driving, compared long-term trends, and established a baseline for measurement of the effects of cannabis legalization. More than 2,500 vehicles were randomly sampled from the traffic flow for participation in the survey (Beirness 2018). The number of vehicles that entered each of the survey sites ranged from 13 to 56 and depended on the volume and pattern of traffic, the time of night, day of the week, the number of refusals, the numbers of drivers who required transportation home, and the capacity of the survey crew to process drivers (Beirness 2018).

Finally, the province passed legislation in spring 2019, giving police new tools to remove drug-affected drivers from roads. The province introduced a new 90-day

Administrative Driving Prohibition (ADP) for drug-affected driving, and a zero-tolerance restriction for the presence of THC for new drivers in the Graduated Licencing Program (GLP). This proposed change mirrors what is now in place for the presence of alcohol for new drivers.

Adapting to the Environment

The goal of variable speed limits is to improve driver safety during adverse weather conditions and to reduce serious crashes in areas where weather patterns are prone to change quickly, which has the potential to make driving conditions more hazardous. The Ministry of Transportation and Infrastructure implemented variable speed signs on three corridors throughout the province as part of a pilot project to help reduce the frequency and severity of weather-related crashes. Ministry staff constantly monitor the system by analyzing the data and improving the algorithms to optimize recommended speed limits that best meet driver expectations and are in line with current conditions. The pilot resulted in 6.7% reduction in serious (fatal and injury) collisions. Flashing lights installed above each variable speed limit sign are activated when a reduced speed limit is in effect. Variable speed limit signs are regulatory; therefore, police have the authority to enforce the speed that is on the electronic sign.

Additionally, the Shift into Winter campaign includes more than 20 organizations working together to form the Winter Driving Safety Alliance. Shift into Winter is geared toward educating drivers and workers about the increased risk when winter weather makes roads more hazardous due to fog, rain, snow, and ice. The program includes an online resource kit for employers, trip planning, online courses, videos, presentations, and meeting guides. Further, each winter the Alliance combines digital highway displays, social media, and advertising to encourage all drivers to plan before traveling during the winter months.

Summary

The province's Vision Zero initiatives have been improving road safety through countermeasures, enforcement, public education and awareness, and through collaboration with partner organizations. In 2017, there were 276 fatal victims of motor vehicle crashes in B.C. While this number is still too high, this represents a decrease of approximately 22% since 2008. The Province has committed to tracking progress in absolute fatality numbers, as well as rate-based targets.

Role of Partners

One of the main principles of Vision Zero is collaboration, and B.C. works with more than 150 representatives from nearly 60 road safety partner organizations – with the common goal of zero traffic fatalities and serious injuries. In 2012, B.C. created the BCRSS, a unique made-in-B.C. approach designed to leverage the efforts of the diverse network of B.C. road safety partners including government, the insurance sector, Crown entities, the health sector, law enforcement agencies, nonprofit organizations, road safety groups and partners, and academic researchers.

Alberta

City of Edmonton

Background

With a population of 972,223, Edmonton is the second-largest city in Alberta and the fifth largest in all of Canada (City of Edmonton 2019; World Population Review 2019). In response to more than 8,200 residents being injured and/or killed on the city's roads that year, Edmonton developed the first municipal Office of Traffic Safety in North America in 2006 (City of Edmonton n.d.-a; Parachute 2017). Since then, Edmonton has been taking major steps to improve road safety, resulting in a 59.8% decrease in the number of people injured from 2006 (8,221) to 2018 (3,307) (City of Edmonton n.d.-b).

Vision Zero Edmonton

City council approved *Edmonton's Road Safety Strategy 2016–2020* in September 2015 and, in doing so, made Edmonton the first Canadian city to adopt Vision Zero (City of Edmonton n.d.-c). Edmonton's Road Safety Strategy takes an evidence-based, Safe Systems Approach, and focuses on the five E's of Traffic Safety: Engineering, Enforcement, Evaluation, Education, and Engagement. Each of the five E's outlines strategies for improving road safety.

Countermeasures

Engineering

The city's goal for engineering is to design the transportation system in a way that anticipates human error, with an aim to prevent serious injuries and fatalities. Road safety audits and assessments, as well as network screening programs and an overall review of data, including collision data, provide the evidence needed to design and implement measures to make Edmonton's roads safer.

Engineering countermeasures include the increased use of prohibited and protected left-turn signals, improved right-turn designs, signalized right turns, upgraded pedestrian signals, improved crosswalk markings, increased use of amber flashers and rapid flashing beacons, implementation of pedestrian scrambles, use of driver feedback signs (speed display), and the use of retroreflective tape on signal heads and additional traffic signal fixtures to improve signal visibility. The strategy further outlines traffic calming strategies to reduce shortcutting, as well as the need for neighborhood speed reduction programs. Safe speeds are addressed through speed limits and speed management. Edmonton uses a continuum of speed management strategies, ranging from the placement of community signs with messaging such as "Give our kids a brake" and speed display signs, to enforcement.

Education

Edmonton's strategy recognizes the importance of education for increasing traffic safety. In 2014, Edmonton established a biennial Traffic Safety Culture Survey to

better understand the behaviors and attitudes of road users (City of Edmonton 2015). The city uses these findings and additional research to inform new educational programs, create an annual traffic safety communications plan and to review existing programs. More than 5,000 residents participated in the 2018 survey (City of Edmonton n.d.-d).

Another unique method Edmonton is using to support education is the Vision Zero Street Team. This team was created in 2017 and brings traffic safety messaging to local events, traffic safety hotspots where new infrastructure has been installed and various locations across the city where there is an opportunity to interact with the public and share information about traffic safety. Most recently, the Vision Zero Street Team was out teaching drivers and pedestrians how to use "pedestrian scramble" style crosswalks. The strategy further encourages collaborative, educational traffic-safety projects with stakeholders to increase exposure and frequency of primary prevention initiatives.

Enforcement

Edmonton's strategy includes the use of enforcement to help reduce risky behaviors, placing an emphasis on speeding, impaired driving, and failure to wear seatbelts, as well as following-too-close, driving distracted, and identification of high-risk drivers. Edmonton employs a data-driven approach, which includes analyzing traffic hotspots to determine priority areas for enforcement. To minimize red-light running and speed-related collisions, Edmonton has installed Intersection Safety Devices that capture red light and speed violations, as well as automated mobile photo enforcement, with a focus on playground zones and high-collision locations. The Edmonton Police Service and the city work together on traffic-related initiatives and targeted enforcement.

Evaluation

Edmonton's strategy involves leveraging the work of the Edmonton Urban Traffic Safety Research Chair at the University of Alberta to evaluate ongoing transportation-related initiatives and develop new methodologies and best practices. The city also conducts research into automated enforcement for collision reduction and optimization of resource deployment. Other evaluation measures include advanced video-based road safety analytics to identify collision risk and the creation of road safety audit criteria.

Engagement

Public engagement is critical to the success of Vision Zero in Edmonton. Engagement activities are conducted to consult with the public about various traffic safety initiatives, such as changes to residential speed limits. Edmonton also engages citizens in other ways. For example, the Annual Run Walk Ride for Vision Zero is a family-friendly event that welcomes people affected by traffic crashes to honor the loved ones they have lost or who have been injured in a crash. There were 120 participants in 2018 (City of Edmonton n.d.-d).

Summary
Edmonton's Road Safety Strategy continues to improve traffic safety. A comparison of 2015 (pre-Vision Zero) to 2018 shows that pedestrian injuries have decreased by 21%, cyclist injuries by 29%, motorcyclist injuries by 26%, and injuries to vehicle occupants by 11% (City of Edmonton n.d.-c, n.d.-e). Overall, serious injuries have declined 17% while fatalities have dropped 41% (City of Edmonton n.d.-c). In 2018, compared to 2017, the Edmonton Police Service issued 2,319 fewer speeding tickets and overall speeds in Edmonton are decreasing (Edmonton Police Service, COGNOS Database 2019; City of Edmonton, Photo Enforcement Ticketing System 2019).

Some of the key successes during the first 3 years of Vision Zero in Edmonton include: the installation of 34 left-turn signal phase improvements; contributing to the redesign of 14 right-turn lanes; addition of 54 signal visibility improvements including retroreflective tape and new signal fixtures; installation of 48 pedestrian signals and/or amber flashers, plus 50 flashing beacons at schools (City of Edmonton n.d.-e); installation of 215 driver feedback signs, which have shown to reduce speeding by up to 12 km/h (City of Edmonton n.d.-d); upgrades to 64 school areas; and the implementation of 30 km/h playground zones, which have led to decreases in speed by 12 km/h (City of Edmonton n.d.-a). In addition, automated mobile photo enforcement has reduced fatal and injury collisions by 20% and speed-related collisions by 18%, while the installation of intersection safety devices have reduced angle collisions by 43% (City of Edmonton n.d.-a).

Role of Partners

The Edmonton experience has highlighted the significance of partnerships in the success of their Vision Zero approach. The city partners with numerous stakeholders, such as the Edmonton Police Service on targeted enforcement and collaborative media events, the University of Alberta and other academic institutions on research and evaluation, School Boards to understand, discuss, and work collaboratively to improve traffic safety around schools, and Community Leagues, community groups and organizations in relation to traffic calming and as part of neighborhood renewal, advocacy groups, businesses, and many others. As Edmonton moves toward the launch of the next iteration of its strategy in 2021, the Safe Mobility Strategy, there will be an increased focus on the lived experience of all road users and ensuring traffic safety for all.

City of Calgary

Background

Calgary is the largest city in Alberta, with a population of 1,267,344 (City of Calgary 2018a). The city currently has 300 km of roadways, nine Light Rail Transit stations, and a 138 km Greenway, a pathway that connects 55 Calgary communities and connects to Calgary paths and trails, creating more than a 1,000 km network (City of Calgary 2016; Parks Foundation Calgary n.d.). The Greenway accommodates a 40% increase in cyclists in Calgary, resulting in more than 17,100 cycle trips every day

(City of Calgary n.d.-a). Downtown, the city also has the Plus 15 network, with 83 enclosed bridges connecting office towers to allow a safer way for pedestrians to travel (City of Calgary n.d.-b).

Despite the variety of options available for multimodal travel in the city, there were 517 major injury collisions and 11 fatal collisions on Calgary's roads in 2017 (City of Calgary 2018b). To take action against preventable tragedies, Calgary adopted Vision Zero and introduced its most recent *Safer Mobility Plan 2019–2023* in 2018.

Vision Zero in Calgary

The City of Calgary's movement toward Vision Zero first began in the *Calgary Safer Mobility Plan 2013–2017*. This document is aligned with the Province of Alberta Traffic Safety Plan, Transport Canada's Road Safety Strategy, and the Global Decade of Action. The plan is based on a vision of safe mobility for all users and a mission to strive for zero… "pursuing transportation completely free of fatalities and injuries" (City of Calgary 2014). The plan is also built around the values of the Safer Systems Approach (safer infrastructure, safer users, safer speeds, and safer vehicles), continuous improvement (short-term target toward the long-term goal), evidence-based strategies (Engineering, Education, Enforcement, Evaluation, and Engagement), collaboration (internal, external, and community), and best practices (research, technology, and innovation).

The *Calgary Safer Mobility Plan 2019–2023* builds on the work completed during the previous term (2013–2017) with simplification of targets, increased funding, and investment in infrastructure, and continued focus on partnerships, collaboration, and engagement. Vision Zero takes a more-prominent position in the document continuing the vision of "mobility free of major injuries and fatalities" (City of Calgary 2018b, p. 2). The numerical target of 25% reduction over a five-year period is set for both major injuries and fatalities, as well as for all road users and vulnerable road users. The City of Calgary has supporting documents that identify improvements to its transportation infrastructure to support safer outcomes for users. These documents include the Calgary Cycling Strategy, the Complete Streets Guide, the Pedestrian Strategy, and the Traffic Calming Guide, and the overarching policy documents the Calgary Transportation Plan and the Municipal Development Plan.

Countermeasures

Community Traffic Safety Meetings

Community traffic safety meetings are a joint activity between City staff and Calgary Police Service, and are attended by partners of the Safer Mobility Operations and Community Teams. These events include presentations about traffic safety issues and initiatives by City and police staff as well as discussions with citizens about their concerns. Concerns are received and form another piece of information to guide safety improvements and citizens are made aware of ongoing work and programs that they can access for assistance with their concerns.

Rectangular Rapid Flashing Beacons

Calgary led the national development of traffic control guidelines for the use of Rectangular Rapid Flashing Beacons (RRFBs) through TAC (Transport Association of Canada n.d.). RRFBs use LED lights in rectangular arrays and with a varying flash pattern to alert motorists to the presence of pedestrians at signed and marked crosswalks. The pilot study in Calgary demonstrated dramatic improvements in yielding behavior, from about 70% before, to 90% + post installation (Mishra et al. 2015).

Traffic Calming Policy and Investment in Changing Infrastructure

The Calgary Police Service (CPS) has a dedicated Traffic Safety Unit that responds to community concerns through their Traffic Service Request program. The CPS also runs staffed enforcement of traffic laws through its Districts and with Mobile Photo Enforcement vehicles using Traffic Section staff, as well as static enforcement at intersections using Intersection Safety Devices that enforce red-light-running violations as well as speed infractions during green lights. Calgary Intersection Safety Devices were included in studies completed by the Province of Alberta about the effectiveness of red-light cameras and speed cameras (AECOM 2014a, b).

Calgary has also invested in changing infrastructure. Roundabouts have increasingly become a traffic-control method of choice when traffic conditions allow. Many new communities are being built with roundabouts as the preferred intersection type for larger roads within communities. A network review of roundabouts in Calgary found that collision rates at roundabouts are less than half of those at signalized intersections (J. Domarad, personal communication, April 15, 2016). Calgary was also the first city in Canada to have an operational Diverging Diamond Interchange (City of Calgary 2019a). This interchange type applies principles of roundabouts to an interchange design by changing left-turn conflicts to merge/diverge type movements.

Further, one of the many network reviews completed in the city as a part of the Safer Mobility Plan was a review of all divided roadways to assess the need for median barriers to prevent or reduce cross median collisions and to prioritize based on collision history (Mishra and Churchill 2014). The use of High Tension Cable Barriers, where space and conditions allow, has been adopted to minimize the risk to vehicle occupants.

Calgary has also piloted and adopted Traffic Calming Curbs to rapidly change the built environment at a low cost (Churchill et al. 2017). These devices are best used as temporary measures to prototype potential changes and evaluate the benefits to advocate for more permanent changes. The City of Calgary received the TAC 2019 Road Safety Engineering Award for the invention and use of this device (City of Calgary Newsroom 2019).

Calgary has been using computer vision technology to quantify near misses using Video- Based Conflict Analysis as well. The proactive collection of conflicts allows evaluations and adjustment to designs to minimize risk, rather than waiting for collisions to occur so that they have data to analyze. Although this is a developing

field, the benefits of making corrections to designs are clear, and the City is looking to move beyond traditional reliance on collisions as a design input.

Harmonization of School Zones and Playground Zones

Calgary had reduced speed zones (30 km/h) near school zones and playground zones that had different start and end times and days during which they were in effect. Two stages of harmonization took place: the first stage harmonized the times to start at 7:30 a.m. and end at 9:00 p.m.; the second stage converted all school zones (only in effect on school days) to playground zones that are in effect 365 days a year. The pre-post study revealed that speeds reduced by 6 km/h on average and resulted in a significant improvement in safety in those zones (Mishra and Kattan 2017).

Review of Neighborhood Speed Limits

The City is reviewing unposted and posted speed limits for neighborhoods in 2019 (City of Calgary 2019b). The review includes extensive education and stakeholder engagement, evaluation of alternatives, supporting traffic calming, and potential changes to enforcement. Council has requested a recommendation by the end of 2019 and this may be a significant step toward Vision Zero.

Role of Partners

Collaboration is a focal point of the plan and internal and external stakeholders are engaged through four groups that work in concert to advance the actions in the plan. These groups are the Safer Mobility Leadership Team, The Safer Mobility Operations Team, The Safer Mobilities Communities Team, and the Safer Mobility Research Team; additional information about membership of these teams is provided in the Safer Mobility Plan. The City of Calgary is actively involved in the exchange of information with other municipalities directly and through the TAC, CARSP, Institute of Transportation Engineers (ITE), Canadian Association of Chiefs of Police (CACP), and other organizations.

City of Fort Saskatchewan

Background

Located in Alberta's industrial heartland, and to the northeast of Edmonton, The City of Fort Saskatchewan is home to 26,942 residents (City of Fort Saskatchewan 2019a). The city hosts many community events throughout the year, encouraging residents to use the city's roads and more than 75 km of paved walking and biking trails to travel throughout the community (City of Fort Saskatchewan 2019b). Two major highways transect the city and accommodate about 50,000 vehicles per day through each major intersection, many of which transport dangerous goods (City of Fort Saskatchewan 2019b). It has been estimated that about 608,090–680,849 commercial vehicles travel annually through the corridor (City of Fort Saskatchewan 2019b).

In 2018, Fort Saskatchewan had 43 fatal and injury collisions (City of Fort Saskatchewan 2019b). While this is a significant decrease from previous years, the

city remains committed to reducing this number to zero. Fort Saskatchewan introduced a new traffic safety plan for 2019–2022, which continues their commitment to Vision Zero.

Vision Zero

The City of Fort Saskatchewan adopted Vision Zero and the Safe System Approach in 2018 as their main approach to traffic safety. The five E's of traffic safety – engineering, education, enforcement, engagement, and evaluation – form the foundation of their effort to make the city's roads safer. While the plan supports Alberta's traffic safety strategies for community-based delivery of traffic safety programs, initiatives, and communications, as well as the Capital Region Intersection Safety Partnership joint vision, Canada's Road Safety Strategy 2025, and RCMP Traffic Services Safety Strategic Plans, it is also designed to meet the needs of Fort Saskatchewan (City of Fort Saskatchewan 2019b).

The plan aims to enhance the safety of motor vehicle drivers, bicyclists, and pedestrians on roads, pathways, and trails, with four main objectives: reducing the number and severity of injury and property damage collisions through identifying top five collision locations and the causal factors, and developing a strategy to reduce frequency and severity; enhancing traffic education; identifying and removing impaired drivers from roads; and identifying and sharing engineering concerns with the City's infrastructure department to improve road safety.

Countermeasures

Education

Fort Saskatchewan places a focus on working with the public and partners to educate all road, pathway, and trail users in the city. The City implements countermeasures, such as speed display boards, to increase driver awareness of speed, and encourage them to comply with applicable traffic laws. Option 4 programs are also available as an educational opportunity. Enforcement is focused on a specific risk factor. Any resident who receives a ticket can attend an educational session to learn about the risks associated with their violation and, upon proof they have attended a session, the ticket will be converted to a warning. The City notes that the results from this option have been exceptional, with residents commenting on their new understanding of traffic risks and desire to change their behavior.

Various education opportunities are available for youth as well. Bicycle rodeos are designed to teach youth about riding bicycles safely and each participant's bicycle is fixed if there are any safety issues present. If participants need new helmets, they are donated by Protective Services and Prairie EMS. Further, school traffic safety training is offered by RCMP and municipal enforcement. Officers deliver classroom presentations on topics such as school bus and pedestrian safety, drug and alcohol topics, and the laws around motor vehicle equipment.

Finally, internal education is offered to officers to increase their awareness of collision contributors in the city, which also involves ongoing data analysis, and development of strategies to reduce collisions. The Municipal Enforcement Services

supervisor also distributes messages to the public through local media and their website on a weekly basis, which focus on emerging traffic safety needs.

Enforcement

The City of Fort Saskatchewan uses both conventional and automated enforcement to help enforce traffic laws, create awareness about traffic safety, and encourage compliance from the public. Enforcement is enhanced in key areas, including school, playground, and high- collision locations. Photo-laser and intersection safety cameras are also installed to provide automated enforcement.

Engineering

The City also places an emphasis on designing safe roads and creating and implementing effective traffic control devices. To do so, a portion of revenue from traffic fines goes toward furthering traffic safety in priority areas. Engineers in Fort Saskatchewan have also developed a policy for traffic calming that will be considered in the development of any new roads.

Evaluation

Fort Saskatchewan also assesses the effectiveness of its education, enforcement, and engineering initiatives. The City's Protective Services department has an analyst responsible for traffic analysis who provides the RCMP and Municipal Enforcement Services officers with weekly collision reports, making note of any trend updates. Any repeat violators or violators considered to be high risk are contacted to engage in a discussion on traffic safety. Further, Protective Services also partners with Capital Region Intersection Safety Partnership, supporting traffic safety priorities in the province every year, including participating in Selective Traffic Enforcement Program initiatives. The City notes that, regardless of the strategy used, it evaluates the strategy for efficacy and adjust in any way necessary to meet the needs of the community.

Engagement

Fort Saskatchewan works with members of the community in determining areas of concern and aims to engage the community to resolve traffic safety issues in the city. A Traffic Safety Working Group has been formed, including multiple departments in the City and members of the community, to discuss road safety concerns and enforcement trends to help contribute to innovative road safety solutions. Protective services also have held a Town Hall session for members of the community to share concerns, and it also offers an online service tracker where community members can submit service requests, including traffic-related services.

Summary

The rural city of Fort Saskatchewan has seen immense success with its traffic safety initiatives and countermeasures. Since 2008, the city has seen a 59.1% decrease in the rate of fatal and injury collisions (City of Fort Saskatchewan 2019b). Thus far, the city has installed nine intersection safety cameras and additional photo-laser

devices, has conducted eight pedestrian safety presentations, and has also lowered speed limits in select areas, redesigned major roadways, and improved street lighting (City of Fort Saskatchewan 2019b). There has been a 71% decrease in red light violations at intersections with intersection safety cameras, a 35.8% reduction in overall fatal and injury collisions despite population growth, and $6.98 million in savings due to collision costs in 1 year (City of Fort Saskatchewan 2019b).

Role of Partners

The Director of Protective Services chairs a Traffic Safety Working Group that brings together traffic engineers, transportation and roads staff, Municipal Enforcement Services officers, RCMP traffic officers, the Fire Services, representatives from both School Boards, and the Regional Coordinator for Alberta Infrastructure and Transportation. On an ad-hoc basis, subject matter experts contribute to the group's planning and discussions. Their contributions have been incorporated into the traffic safety plan. The Traffic Safety Working Group also includes members of the community, and the group meets to discuss road safety concerns and enforcement trends to help contribute to innovative road safety solutions.

Ontario

City of Toronto

Background

Toronto is Canada's largest city, with more than 2.8 million residents (City of Toronto 2016). One quarter of Toronto's public space is made up of roads (Toronto Centre for Active Transportation n.d.), and more than three million trips are made to destinations across the city on any given weekday (City of Toronto 2016). Toronto currently houses 5,600 km of roads, 130 km of expressways, 9,500 streets, 26,300 intersections, a 900 km cycle network, 8,000 km of sidewalks, 480 pedestrian crossovers, and one million traffic signs (City of Toronto 2016).

In 2018, there were 66 people killed and 346 people seriously injured on Toronto's roads (City of Toronto 2019a). Nearly 82% of traffic fatalities involved vulnerable road users, such as pedestrians, cyclists, and motorcyclists (City of Toronto 2019a). Of all those involved in fatal collisions in Toronto in 2018, 62% were pedestrians, 18% were in cars, 14% were on motorcycles, and 6% were on bikes (City of Toronto 2019a). Safe streets in Toronto are critical to ensure that residents and visitors can move about safely, regardless of location, time of day, or mode of transportation.

Vision Zero in Toronto

After 2 years of development with 12 partner agencies and approval from Toronto City Council, the City of Toronto introduced its 5-year *Vision Zero Road Safety Plan (2017–2021)* in 2016. Given the size and complexity of Toronto, the City takes a data-driven approach to effectively prioritize safety improvements based on location

and specific needs. Considering KSI collision trends and geospatial analysis, the City identified collision patterns, such as most vulnerable road users, circumstances surrounding KSI collisions, and collision hotspots (City of Toronto 2016). This data was used to establish emphasis areas and countermeasures.

The *Vision Zero Road Safety Plan* outlines six emphasis areas: pedestrians, school-age children, older adults, cyclists, motorcyclists, and aggressive and distracted driving. The 2016 plan outlines more than 50 countermeasures to address each emphasis area and related road safety risks. In year one, Toronto focused on the reduction of Killed or Seriously Injured (KSI) collisions. As the plan has continued to evolve, the city has been looking to prevent collisions before they happen with collision forecasting and a focus on causal factors. To refocus efforts and enhance progress, Toronto City Council approved *Vision Zero 2.0* in 2019.

Vision Zero 2.0

Vision Zero 2.0 represents a renewed commitment to the Vision Zero approach and an updated focus on efforts that will be most effective in achieving Toronto's road safety goals, as well as the addition of Heavy Trucks as a seventh emphasis area. The plan will focus on proactive systemic safety analysis of collisions involving vulnerable road users, speed management strategy, and geometric safety improvements, among various other goals such as additional mid-block crossings, increased police enforcement, and development of district safety plans (City of Toronto 2019b).

In keeping with the City's data-driven approach, staff working on Vision Zero 2.0 are reviewing demographic data, travel behavior, built road environment, five-year KSI trends, type of road users involved in KSIs, severity of collision outcomes, top KSI collision types in emphasis areas, road user actions contributing to KSIs, age of drivers and collision victims, relationship between road classification and KSI trends, relationship between time of day, month, light condition and KSI trends, hotspot mapping of intersection and mid-block KSIs, and public opinions on road safety (City of Toronto 2019c).

Countermeasures

Programs, Initiatives, and Strategies

There are a number of programs in place to address each emphasis area in Toronto's plan. The "Missing Links" Sidewalk Program includes a policy to install sidewalks in areas with no sidewalks or where there are gaps in the sidewalk network to ensure that all pedestrians can travel safely to and from their destination. The Geometric Safety Improvements Program implements road improvements and changes to intersection design to address safety issues. New in the plan, pedestrian safety corridors are being installed and include measures such as targeted speed limit reductions, signal timing adjustment, and enhanced crosswalk markings. A local road pedestrian crossover pilot has been conducted to assess the possibility of new types of pedestrian crossovers to enhance protection for pedestrians as well.

School-age children are an emphasis area in Toronto's Vision Zero plan, with the establishment of School Safety Zones around all schools being a key undertaking to

help raise awareness of drivers to the presence of school-age children in the area and lower speeds. School Safety Zones include lower speed limits, increased enforcement, improved pavement markings, and flashing beacons and LED display signs. The School Crossing Guard Program is being reviewed as part of a recent transition of the program from the Toronto Police Service to City of Toronto. The plan also outlines a community-based initiative to plan active, safe routes to school, and the bicycle helmet initiative promotes helmet use and wheeled-transportation safety among school children.

To address the safety of older adults, Toronto has implemented "Senior Safety Zones" to introduce measures to improve senior road safety at high-priority locations. These include lower speed limits, advance green lights for pedestrians, watch your speed driver feedback signs, additional mid-block crossing opportunities, increased crossing times at signals, decreased crossing distance, increased enforcement, and improved pavement markings. A Priority Snow Removal Program is also offered, which allows adults over the age of 65 to apply to have snow removed in front of their residence. Bringing an Awareness of Senior Safety Issues to the Community (B.A.S.S.I.C.) delivers safety seminars and a safety calendar to improve the safety of older adults on Toronto's roads. The City's overall "Senior's Strategy" features an accountability table to ensure all issues affecting senior citizens, including transportation and road safety, continue to be a priority.

In 2016, Toronto introduced the Ten Year Cycling Network Plan, which aims to improve safety for cyclists. The City has installed cycle tracks, bike lanes, shared lane pavement markings, and multiuse trails (City of Toronto 2019d). The City will continue to improve cycling infrastructure in the coming years. There are also a number of intersections across Toronto that are being protected for cyclists as part of a pilot project. Further, motorcyclists are at risk on busy city roads, due to the lack of protection, higher speeds, and their limited visibility for other drivers on the road. Project E.R.A.S.E is supported by Toronto Police to address motorcyclist safety and reduce illegal street racing.

Enhanced Enforcement

Enforcement activities are emphasized in Toronto's Vision Zero plan and are done in collaboration with Toronto Police Service and Ontario Provincial Police (OPP). Enforcement strategies are data-driven, meaning police are provided with reports identifying the locations where there have been the most collisions in each emphasis area. Automated enforcement, such as speed enforcement and red-light cameras, are being installed in priority areas. The Red Light Camera program will be doubled in size in 2020 to meet growing demand, Areas where new safety measures are implemented, such as new mid-block crossings, receive enforcement support as well (City of Toronto 2016).

Enforcement strategies are tailored to each emphasis area and focus on priority locations. In school zones, enforcement focuses on offenses relating to pedestrian crossovers, school zone speed limits, intersections, school crossing guards, stopped school buses, and parking regulations. Additionally, enforcement will be enhanced around driver behavior that compromises cyclist safety, such as improper use of

bicycle lanes and cyclist infractions to improve understanding of laws. Motorcyclist safety and aggressive and distracted driving will be targeted with enhanced enforcement efforts and enforcement has also increased in areas frequented by older adults (City of Toronto 2016). Police have also run "Operation Impact," an enforcement campaign targeting distracted and aggressive driving.

Educational and Awareness Campaigns

Education and awareness initiatives are run by various road safety delivery partners including Toronto Public Health, Toronto Transit Commission, School Boards, Toronto Police, and City of Toronto and are developed for each emphasis area. These initiatives help build skills, educate and raise awareness of safety risks and steps to improve safety for road users. Targeting pedestrian safety, the "March Break March Safe," "Stay Focused Stay Safe," and "Step Up Be Safe" campaigns enhance education, awareness, and enforcement of pedestrian safety, including issues such as unsafe mid-block crossings and vulnerable road users committing offenses near pedestrian crossovers. Further, road safety of older adults is addressed through Sunnybrook Health Sciences Centre's iNavigait campaign, which helps to ensure the safety of seniors, addressing dangers for older adults on roadways.

Additional campaigns, including the "Please Slow Down" campaign by the City, which provides residents with lawn signs to encourage drivers to slow down, and "You Know You Shouldn't... So Don't" campaign, a series of YouTube videos addressing aggressive driving, have also been implemented to target aggressive driving. To address motorcyclist safety, the Spring Motorcycle Awareness Campaign was designed by Toronto Police to coincide with the start of motorcycle season, focusing on equipment safety, rider protection, and training. Similarly, educational materials exist for cyclists, including helmet safety videos and the Toronto Cyclists handbook, which teaches about traffic laws and safe cycling. "Space to Cycle," an educational campaign led by Toronto Police Service that focuses on motorists whose actions endanger the lives of cyclists and risky cyclist behavior on roadways, and the "Stay Safe, Stay Back" campaign, which promotes safe interaction between cyclists and large trucks, are also run to promote cyclist safety.

Pavement Markings

Pedestrian crosswalk enhancements have been made, including pavement markings, zebra stripes at crossings, increased crosswalk widths, and stop bars. Toronto has also designated cycling conflict areas, where green pavement markings are implemented at or near intersections to highlight conflict areas between cyclists and motor vehicles. Bike boxes are painted to ensure that cyclists can proceed first at a green light and cross intersections safely and existing pavement markings delineating cycling infrastructure are refreshed on an ongoing basis. The City is also implementing painted intersection corner bump-outs with bollards as interim geometric safety modifications in advance of capital road work.

Traffic Control Signal Changes and Enhancements

The installation of LED blank-out signs is being piloted to depict prohibited left and right turns (City of Toronto 2016). Signalized crossings and advanced green lights for pedestrians and cyclists are also being expanded across the City, as well as no-right-turn-on-red prohibitions at key locations (City of Toronto 2016). Additionally, street lighting and accessibility measures at signals are being improved in the plan. Automated cyclist detection is another possible countermeasure under study as a means to optimize intersection operations and reduce the risk of cyclists being unable to pass through an intersection before vehicles (City of Toronto 2016).

Speed Management

The City advocates for and plans to pilot automated speed enforcement in school zones and continue to include permanent "watch your speed" display signs in school zones. The mobile "watch your speed" program has been implemented in multiple emphasis areas to address dangerous speeding behavior, as well. The city has also reduced speed limits from 60 km/h to 50 km/h on majority of major arterial roadways with further reductions from 50 km/h to 40 km/h on select roads. The multi-year plan is to reduce most collector roadways to 40 km/h and local residential roadways to 30 km/h in some areas, using neighborhood gateway signage and pavement marking. Additionally, new corner radius design and right slip lane replacement is being looked at to reduce speed and improve safety.

Data-Analysis and Safety Assessments

Toronto regularly analyzes collision data to determine trends and the need for interventions. When the data show that collisions are increasing or failing to improve, this represents the need for more countermeasures in those areas and a look at which are effective, and which may not be doing what they are intended to do. The City of Toronto analyzes data to understand the needs of the public and priorities to ensure they spend their budget appropriately. An example is a systemic review of high-risk mid-block crossing locations. The analysis will help identify the location of new signalized mid-block crosswalk by taking into account pedestrian desire lines and attractors in addition to other variables. Another example is the data-driven approach to the widescale rollout of Leading Pedestrian Intervals (LPIs) over the next several years.

Further, the city developed a "Traffic Calming Guide for Toronto" to review typical traffic calming options, including their cost and effectiveness, and the City and Toronto police aim to implement data-driven enforcement strategies as well. Road safety reviews will be required to address pedestrian safety and the approach to aggressive and distracted driving outlines enhanced data collection, analysis, and reporting (City of Toronto 2016).

Summary

In 2018, the City launched the Active and Safe Routes to School pilot at five schools, deployed mobile watch your speed signs in every Toronto ward, made numerous cycling enhancements, ran a pilot for rapid deployment of geometric safety

improvements, improved street lighting, and held various public education campaigns, to name just a few achievements (City of Toronto 2018). To date, the City of Toronto has also installed 510 community safety zones, 64 senior safety zones, 156 school safety zones, 63 traffic signals, and pedestrian crossovers, 146 pedestrian head-start signals, 78 red-light cameras, 239 accessible pedestrian signals, and 21 LED blank-out signs (City of Toronto n.d.).

Role of Partners

The City of Toronto's *Vision Zero Road Safety Plan* was developed using a collaborative approach with partner agencies, external stakeholders, advocacy groups, and the public. Partners on the plan include those that have supported and worked on road safety, including Toronto Police Service, Toronto Public Health, Toronto Transit Commission, the Disability, Access, and Inclusion Advisory Committee, CARP, Toronto Seniors Forum, the Canadian Automobile Association (CAA), Cycle Toronto, Walk Toronto, Toronto District School Board, Toronto Catholic District School Board, Sunnybrook Health Sciences Centre, the Rider Training Institute, Motorcycle and Moped Industry Council, The Centre for Active Transportation, Culture Link, Friends and Families for Safe Streets, and Sick Kids Hospital. A representative from each of the five main delivery partner agencies also forms the Vision Zero Road Safety Working Group, which meets quarterly to review progress, priorities, issues, and plan future Vision Zero initiatives.

The Toronto Police Service assists with enhanced enforcement and runs a number of campaigns and projects aimed at enhancing road user safety. Partner organizations, such as Cycle Toronto, assist with producing materials such as the Toronto Cyclists Handbook. Other partner organizations, such as Sunnybrook Health Sciences Centre, Toronto Public Health, and CAA, run programs for target populations, such as older adults and school children. Each partner uses their expertise to contribute to and enhance countermeasures.

Québec

Ville de Montréal

Background

Montréal is the largest city in the province of Québec: its one million population (rising up to four million in the metropolitan region) represents a vibrant society and the city was the top economic performer in the country in 2018 (Conference Board of Canada 2018). This context led to many initiatives in transportation to boost the economy and to curb congestion and road safety issues. Accordingly, major issues were raised in the 2008 Transportation Plan and road safety was embedded in two of the 21 initiatives that are part of this plan: implement a Pedestrian's Charter and increase roads safety through education, enforcement, and engineering. These initiatives were partly implemented in the following years, including the establishment

of a Transportation Safety Office within the city, and the systematic review of intersection design where there were too many collisions.

Despite these efforts, the decrease in road injuries seen in the early 2000s is now stagnant: there is still an annual mean of 14 pedestrian, two cyclist, and 10 car occupant deaths, far too many when thinking about the cost of a lost life (City of Montréal 2018). Facing this growing concern, elected officials from the city first launched a Vision Zero initiative in 2016, reinstating the road safety content from the 2008 Transportation Plan. This was seen as a first step toward a real Vision Zero action plan, which was officially launched in 2018.

Vision Zero in Montréal: Three Goals to Achieve Best Practices

Montréal's Vision Zero action plan (2019–2021) is based on three major themes: promote collaboration, change attitude, and transform the road system. Each theme has several related actions to be taken within the first 3 years. As in other Vision Zero cities, the first step to embrace Vision Zero principles relies on the creation of a strong, participative, and interdisciplinary governance, convinced of the benefits of this change in the road safety paradigm.

To promote collaboration, the city is moving forward with five actions: Provide leadership that will create a ripple effect throughout the Montréal community and bring Vision Zero to life over time; Develop collaboration to ensure the sustainability, integrity, fairness, and transparency of Vision Zero; Develop effective communication channels among the city, partners, and citizens; Share responsibility for the safety of the street network among all partners; Set common targets to help achieve the overall goal of zero deaths and zero serious injuries.

To change attitude and ways of doing things, the City suggests several actions that can be implemented first within its staff and strongly encourages partners to do the same within their workforces: mobilize road system designers and managers to increase safety and let them become change agents; foster interdisciplinary development and dissemination of new knowledge to better understand our environment; measure ways of doing things and intervene more effectively; accelerate the implementation of best road-design practices through the dissemination of guides and the revision of development standards; better coordinate awareness and education campaigns; and ensure the development and maintenance of driving skills with the appropriate training.

Finally, to transform the road system, the City and its partners target 12 actions: plan road-sharing between the different modes of transport for the entire network in order to offer accessible, safe, and effective mobility options; create safe, user-friendly, and accessible pedestrian walkways, with particular attention to intersections; ensure compliance with speed limits and reduce transit traffic on local streets and in sensitive areas; improve Montréal's standards for the upgrade and deployment of the cycle network; improve the public transit offer and promote its safety as a mode of transportation; better integrate the needs of vulnerable road users into the design and programming of traffic lights; adopt simple, clear, and durable signage and marking to help all road users to understand their meaning; harmonize street lighting to ensure better visibility for all road users; ensure that parking is no longer

an obstacle to the establishment of safer infrastructures; ensure a better coexistence between heavy vehicles and vulnerable road users; better adapt construction site management to the reality of vulnerable road users; participate in the development of vehicles safety devices through technological watches or pilot projects.

Four Keys to Vision Zero Success: The Montréal Vision Zero Action Plan Has Them All!

One interesting point about the Montréal Vision Zero action plan is the clear presence of the four essential elements for Vision Zero success. First, many actions in all themes will help to develop new knowledge in road safety, both within and outside the city staff. This new know-how can then be used to change the way we see the road system to better include users' vulnerabilities and to build it so potential mistakes are forgiven.

Secondly, the strong will found in the action plan to work in partnership is the right answer to the four "Ps" needed to achieve Vision Zero: strong support from the Politics in power, the Public servants, including City and police staff, the Press (a major communication plan is related to this plan), and the Population. This support is first seen by asking as many partners as possible, including Montréal's own city division and teams to be "committed to road safety" by signing the declaration of commitment on its website. There are already several partners committed and more signing each month, either simple citizen or bigger organizations. In addition, the consultation prior to this plan highlighted more than 400 local initiatives in road safety across the city, coming from either city's services, nonprofit, or private firms. This confirms the partners' awareness of the role they can play in improving the safety of the road system.

Third, there are many evaluation and feedback opportunities embedded in the action plan, two major points when it comes to evaluating the success of actions in a Vision Zero approach. The first feedback loop is within the governance plan, where there are three thematic working groups (crosswalks, heavy vehicles, and speed management), one advisory committee (vulnerable road users), and one committee on data management in charge of producing an annual road safety statistics report. All these committees will be listened to by the city staff responsible for the VZ action plan.

Finally, this first Montréal Vision Zero plan also provides budget and dedicated staff for the implementation of actions and also for the evaluation of the effects. For example, the first theme includes an action to "create a Vision-Zero-dedicated team and filling seven additional positions for the implementation of the action plan," and the second and third theme include budget for research, including the evaluation of pilot projects.

Summary

Between road infrastructure maintenance and the need for more sustainable mobility, the city of Montréal Vision Zero action plan is a good start to make sure that road safety challenges, such as safe speed in local neighborhoods, new technologies and distracted driving, and aging of the population are addressed. This three-year plan is promising by its content and the willingness it depicts from several key actors. The whole road safety community is looking forward to seeing the impacts of this first plan.

Role of Partners

The City of Montréal outlined from the beginning that collaboration would be essential to its Vision Zero strategy. Accordingly, more than 30 local and provincial stakeholders signed a declaration of commitment in the first City's VZ Action Plan (City of Montreal, 2019: https://portail-m4s.s3.montreal.ca/pdf/vision-zero-ville-de-montreal-2019-2021.pdf). The governance model found in this first action plan is based on interdisciplinarity, including several working groups where four priorities were set by participative stakeholders: speed, heavy vehicle, road crossing, and data management (City of Montreal, 2021: https://portail-m4s.s3.montreal.ca/pdf/etat_de_la_securite_routiere_2020vdem_0.pdf).

Partners were involved in the development of Montréal's Vision Zero plan. After a synthesis of Vision Zero components was developed based on a literature review and case studies, the City of Montréal held meetings with key stakeholders. These meetings included personnel from the public health department, the police department, and public transportation agency, resulting in an evaluation of the safety of Montréal's road network in regard to each component of Vision Zero. Recommendations were then made by comparing the results and, in collaboration with City staff, actions were prioritized according to current opportunities in the city (WSP 2018).

Looking Toward the Future

Government plays a leading role in the uptake and implementation of Vision Zero as the resources for planning, development, implementation, and evaluation reside with the jurisdiction responsible for road safety, whether that is the provincial, territorial, or municipal level. Advocacy by government officials helps to make a valid case for funding and, for a plan such as Vision Zero, which aims to make large-scale changes, government co-operation, and advocacy are essential.

As important, the public drives demand for Vision Zero, setting out the expectations people have from their city and the streets that run throughout it. The public brings awareness to road safety issues, drives community engagement, plays a key role in getting Vision Zero on the agenda and in getting it implemented city-wide. Public opinion can inform effective progress, enhance cooperation, and adherence to road safety rules, help those involved in Vision Zero planning to understand perceptions and behaviors of road users, and allow the city to tailor its Vision Zero efforts to specific road user needs.

Data-driven approaches to Vision Zero allow a regular analysis of collision data to determine trends and the needs of the public and priorities for interventions. Robust evaluation methods can track the successes of countermeasures implemented and look at which are effective and which are not doing what they are intended to do. The countermeasures implemented must be convenient, appealing, and demanded by the public for them to be put to use. Evaluation data can demonstrate

success and ensure support from the public, government, partners, and stakeholders for ongoing and future Vision Zero initiatives. The demonstration of a jurisdiction's success also helps encourage other cities to adopt Vision Zero in their road safety plans.

Vision Zero continues to gain momentum across Canada and the idea of creating more livable cities is sparking conversations across sectors. However, it is not without its challenges, whether that is criticism directed at the types of actions being taken, the speed or lack thereof of the implementation process, the location of interventions, the debate among road users, and their rights to use the roadways or the perception that the goal itself is not achievable. It is critical to look at the progress that has been made and consider how Vision Zero can continue to be effectively implemented and the most efficacious solutions are widespread moving forward, including application in different sectors. It is firstly important to outline Vision Zero priorities for the future. Key Vision Zero priorities include: raise awareness of the issue and tie to global initiatives whenever possible; align the efforts of various levels of government (while cities are the lead, provincial, and federal government should be involved as well); ensure there is money to implement action plans; communication between jurisdictions to exchange best practices; align the efforts of ministries and departments within the various levels of government; overall, make road safety a national priority. Ensuring road safety is at the forefront of public attention and government support will help all jurisdictions to move forward.

For Vision Zero to be successful, there needs to also be an overarching agreement on the issues and the systems nature of the problems and the required solutions. Doing so will allow for larger changes to be made, rather than taking small, and sometimes less-effective steps toward zero. A welcome opportunity is the drive to collaborate and share information among local jurisdictions and disciplines, which provides the potential to create political pressure to keep up with others and leverage lessons learned to accelerate improvements in road safety.

Vision Zero is an approach with a goal of zero serious injuries and fatalities and an emphasis on preventative measures that accommodate for human error; and this approach does not have to be limited to road safety. This approach has applicability to various public health topics and injury prevention efforts, because one preventable death is too many.

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