

**Transport 2000 Ontario**

**Report 04-01**

**Spine and Brain Injuries from Vehicle Crashes: The  
Human and Economic Cost**

by  
Natalie Litwin  
with  
Tony Turriffin



**Series on Ontario's Roads: Social, Economic, and Environmental Costs**

**Transport 2000 Ontario, P.O. Box 6418, Station A,  
Toronto, ON, Canada M5W 1X3  
(416) 504-3834  
[www.transport2000.ca](http://www.transport2000.ca)  
January, 2004**

**Transport 2000 Ontario**

**Compte-Rendu 2004-01**

**Traumatismes Vertébraux et Cérébraux  
Suite aux Collisions Routières:  
Coûts Humains et Economiques**

par  
Natalie Litwin

assistée de  
Tony Turritin



**Transport 2000 Ontario, P.O. Box 6418, Station A,  
Toronto, ON, Canada M5W 1X3  
(416) 504-3834  
[www.transport2000.ca](http://www.transport2000.ca)**

**Janvier, 2004**

“But the day soon came when the mountains began to leave them. It started with roads. Engineers in sola topis arrived with their sinister instruments and charted their designs on reams of paper. These were to be modern roads, they promised, roads that would hum with the swift passage of modern traffic. Roads, wide and heavy-duty, to replace scenic mountain paths too narrow for the broad vision of nation-builders and World Bank officials.

...Progress was slow at first, so slow that Mr. Kohlah and all the inhabitants of the hills harboured an irrational hope: the work would never be completed, their little haven would remain unscathed...

But the road continued to inch upwards, swallowing everything in its path. The sides of their beautiful hills were becoming gashed and scarred...

Then the promised rewards began rolling up the road into the mountains. Lorries big as houses transported goods from the cities and fouled the air with their exhaust. Service stations and eating places sprouted along the routes to provide for the machines and their men. And developers began to build luxury hotels.”

Rohinton Mistry, *A Fine Balance* (1995)  
(selections from pp. 259-61; with permission of  
the publisher, McClelland & Stewart)

*Transport 2000 Ontario*  
**Spine and Brain Injuries from Vehicle Crashes: The Human and Economic Cost**

**TABLE OF CONTENTS**

<u>Section</u>	<u>Page</u>
Preface.....	v
Acknowledgements.....	vi
Summary.....	vii
Sommaire .....	ix
I. Introduction.....	1
II. Economic costs.....	3
III. Spine injuries.....	7
IV. Mild traumatic brain injury.....	10
V. Conclusion.....	14
References.....	16
Addendum.....	18

---

*Transport 2000 Ontario*  
**Spine and Brain Injuries from Vehicle Crashes: The Human and Economic Cost**

**PREFACE**

Transport 2000 Ontario is a non-profit public advocacy organization supported entirely by our membership. We promote environmental, economic and socially sustainable transportation. Incorporated in 1992, we have functioned as an advocate for sustainable transportation since the 1970's. Transport 2000 Ontario is one of the regional organizations that make up Transport 2000 Canada based in Ottawa.

Over the years the regional organizations and national office of Transport 2000 have produced dozens of reports on transportation issues in Canada, some done by staff but mostly by volunteers. The present report is based on extensive research by two members of Transport 2000 Ontario who also serve on our Board of Directors. The report focuses on one very significant cost of an automobile dependent society, the health costs to society and individuals of car crashes, a cost generally ignored. The authors have drawn on the knowledge of front-line health care professionals who have intimate and detailed knowledge of the costs and burdens of the traumas that they deal with. But these costs somehow find little place in the public's consciousness. The authors argue that one solution has multiple benefits to for everyone. If transportation investments and priorities were reordered so that public transportation, both urban and intercity, was an attractive alternative, there would not only be the benefits of a more sustainable environment, but also dramatic health benefits in terms of reduced highway injuries and deaths.

Under the previous administration, the Ontario Ministry of Transportation planned a massive expansion of expressways across southwestern Ontario. Residents in many golden horseshoe communities attended the public information sessions required by these highway plans. They forcefully argued that these new highways would lead to sprawl, congestion and increased air and water pollution. They presented a case for transit and rail-based modes of transportation as the alternative, and that it is these alternative modes where the province's transportation investments now should be made. This is the case that Transport 2000 Ontario has argued strongly. We urge the new administration to make Ontario a safer and healthier province by vigorously supporting sustainable transportation modes.

David Leibold  
President, Transport 2000 Ontario  
January, 2004

*Transport 2000 Ontario*  
**Spine and Brain Injuries from Vehicle Crashes: The Human and Economic Cost**

**ACKNOWLEDGEMENTS**

We are indebted to the following people for their generous help and encouragement. David Garlin, Public Affairs, Toronto Rehabilitation Institute, guided us through the complexities of the rehabilitation community, and helped us to make the right contacts. We also benefited greatly from the support of two key physicians, neuropsychiatrist Dr. Michael Sumner, and neurosurgeon, Dr. Charles H. Tator, Professor of Neurosurgery and Chair, University of Toronto, Division of Neurosurgery and Toronto Western Hospital. These two busy professionals generously shared their knowledge and answered our many questions in layman's terms, a feat not easily accomplished. We are also indebted to Jay W. State, Barrister and Solicitor, who was so generous with his time, and who clarified the relevant legal issues facing motor vehicle injury victims. We also thank Dorothy Scierko, Community Intervention Coordinator, Acquired Brain Injury Clinic, Hamilton Health Sciences Corporation, for her helpful explanation of the various types of traumatic brain injury.

We wish to acknowledge the great help of two professionals who put us in touch with suitable subjects for interviews. To preserve the anonymity of our subjects, we cannot name those professionals.

Of the various reports, websites, etc. that our organization has consulted for this report, a special acknowledgment must be extended to SMARTRISK. Its 1999 report, *The Economic Burden of Unintentional Injury in Ontario*, was an invaluable resource. SMARTRISK is a national non-profit charitable organization dedicated to preventing injuries and saving lives.

We also wish to express our admiration and gratitude to Anita Kaiser and three anonymous injury victims who agreed to be interviewed and were so open and honest about their experiences as motor vehicle injury victims. Their profiles will go a long way in giving motor vehicle crash tragedies a human face.

Finally, we thank the board of Transport 2000 Ontario for its support, both moral and financial. We are grateful to Paul-André Larose for translating our Summary into French.

**Please note:** This report may be reproduced for use as an advocacy document provided authorship is acknowledged. This document is also available on the Transport 2000 website at [www.Transport2000.ca](http://www.Transport2000.ca).

**Also note:** The information in this document is taken from both primary and secondary sources. We recommend that those wishing to make reference to secondary sources cited in this document consult and cite the original source.

Natalie Litwin and TonyTurriffin  
Toronto, January, 2004

## Spine and Brain Injuries from Vehicle Crashes: The Human and Economic Costs

### SUMMARY

Transport 2000 Ontario is a non-profit public advocacy organization promoting environmental, economic and socially sustainable transportation.

Our purpose in producing this report is to raise public consciousness regarding the personal cost to Ontarians generated by injuries and fatalities that result from a transportation system based mainly on cars and trucks using roads and highways. According to the Ministry of Transportation, there were 845 fatalities and 81,782 injuries on Ontario's roads in 2001. These roads, the Ministry proudly proclaimed, were the safest in North America. Of these figures, cars, passenger vans, pickup trucks, trucks, delivery vans and tow trucks were involved in 1,135 deaths and 96,819 injuries. (Multiple vehicles can produce one death or injury or more). By comparison, buses (excluding school buses) were involved in 13 fatalities and 624 injuries, streetcars were involved in one fatality and 90 injuries, and railway trains in nine fatalities and 23 injuries for a total of 23 deaths and 737 injuries.

Based on a study of 1996 data by the organization SMARTRISK, we have calculated that motor vehicle crashes in that year led to 15.5 deaths per 1,000 incidents, compared to 3 deaths per 1,000 incidents from falls, the second most frequent cause of accidental fatalities.

We also look at the burden of those human tragedies on the Ontario economy. According to SMARTRISK's research, the direct cost of vehicle injuries in Ontario in 1996 was \$125.4 million and the indirect costs were \$441.7 million for a total of \$567.1 million. That total represents 19.2% of the total unintentional injury costs for the province in that year, second to falls, which had 43.5% of the total unintentional injury costs in 1996.

Although the total cost of injuries is roughly one-half of the economic cost of pollution-related illness, which was calculated by the Ontario Medical Association to be \$1 billion, no dollar figure can truly reflect the tragic and preventable loss as well as the pain and suffering experienced by spine and brain-injured victims whose stories are told in this report. We focus here on two principal types of road crash injuries: spinal cord and column injuries, and mild traumatic brain injuries.

Since spinal cord injuries typically affect the young, the lifetime cost for medical care and lost earnings for an individual can be as high as \$5 million. Car and motorcycle crashes are the leading cause of spinal cord injuries, 42.8% according to a Queen's University research group, and 54.7% according to the Canadian Paraplegic Association.

**Spine and Brain Injuries from Vehicle Crashes: The Human and Economic Cost**

We have profiled two spine-injured victims of motor vehicle crashes. Anita Kaiser is confined to a wheelchair and has the use of half of her body. Her injury resulted from a blown tire that caused the driver to lose control of the car in which she was a passenger. Richard (not his real name) is a former truck driver who can no longer support his family after his car was “t-boned” by an inattentive driver in a second vehicle. Although he is mobile, the injury to his spinal column has left him with a painful disability.

Mild traumatic brain injury (MTBI) is a relative term used to distinguish it from moderate or severe brain injury. The name is somewhat misleading in that this injury can cause life-altering deficits in the mental processes and behavior of a victim. MTBI occurs when an outside force impacts the head. In the U.S., half of all cases are the result of motor vehicle crashes. Since the brain areas affected are responsible for higher cognitive functions, planning, organizing, problem solving and selective attention as well as personality and behavior, the ability to function normally for those who do not recover is severely reduced. Anxiety, depression and pain frequently accompany these grim symptoms.

Anne and Zoe (not their real names) are two MTBI victims of motor vehicle crashes profiled in this report. Both suffer from ongoing emotional deficits and pain. Anne also suffers from cognitive deficits. Both women can no longer be gainfully employed. Their ability to perform routine household tasks is also limited.

There are two methods of reducing the toll of injuries and deaths on our roads. One is to improve driver safety. This is already being done reasonably well by the Ministry of Transportation. In the year 2000, it spent \$151,534,838 on a program called Road User Safety. However, driver safety programs will have only a limited effect since the number of cars and trucks is increasing at a fast rate: 21.24% between 1992 and 2002. By contrast, the rate of increase in the Ontario population between 1992 and 2002 was 13.3%.

The second method is to reduce the number of vehicles on roads by supporting public transportation as an attractive alternative. The 2003 Ontario budget illustrates the priority given to roads compared to public transit: it provided \$1,055 million for highway planning, expansion and rehabilitation, but only \$359 million in “transit assistance” – roughly one-third.

Specifically, the Ontario government should:

- Legislate in the Planning Act an end to sprawling development, a major cause of car and truck dependence.
- Amend the Planning Act to require that planning in all municipalities be consistent with provincial planning policies.
- Reduce the number of vehicles on roads by initiating a moratorium on highway expansion, with a few legitimate exceptions.
- Reinstate stable financial support for public transit.
- Begin the process of designing an intercity bus/rail transportation system to expand commuter rail and inter-city bus/train services as alternatives to driving.
- Shift greater amounts of freight movement to rail.

(Please see the Conclusion for a more detailed list of recommendations.)

*Transport 2000 Ontario*  
**Traumatismes Vertébraux et Cérébraux Suite aux Collisions Routières:**  
**Coûts Humains et Economiques**

**Traumatismes Vertébraux et Cérébraux**  
**Suite aux Collisions Routières:**  
**Coûts Humains et Economiques**

**SOMMAIRE**

Transport 2000 Ontario est un organisme à but non-lucratif de concientisation publique visant une politique de transports qui soit soutenable en termes de coûts environnementaux, économiques et sociaux.

Notre but en produisant ce compte-rendu est de contribuer à une réflexion publique à l'égard des coûts très tangibles pour les Ontariens suite aux blessures et mortalités découlant d'un système de transport axé en grande part sur des véhicules (automobiles et camions) utilisant routes et artères publiques.

Selon les données du Ministère (Ontarien) des Transports, il y eut 845 fatalités et 81,782 blessures sur les routes ontariennes en 2001. Et ces routes, selon les dires du Ministère, sont parmi les plus sécuritaires en Amérique du Nord.

Parmi les données pour l'an 2001, les sedans, familiales, camionnettes, camions, véhicules de livraison ainsi que les camions de remorquage furent impliqués dans 1,135 mortalités, ainsi que dans 96,819 blessures. On notera qu'un seul cas de mortalité ou de blessure peut être le résultat d'un incident impliquant possiblement plusieurs véhicules.

En comparaison, les autobus (excluant les autobus scolaires) furent impliqués dans 13 mortalités et 624 blessures, les tramways, dans 1 mortalité ainsi que 90 blessures, et le ferroviaire voyageur, dans 9 mortalités et 23 blessures; ceci correspond à un total de 23 décès et 737 blessures.

Utilisant une étude de SAUVE-QUI-PENSE (SMARTRISK) pour l'an 1996, on a démontré que les incidents routiers furent la cause de 15.5 mortalités pour chaque 1,000 cas. Pour mettre les choses en perspectives, notons que cela se compare à 3 mortalités pour chaque 1,000 incidents dûs aux chutes, ce type d'accident étant la deuxième plus fréquente cause de décès accidentel en Ontario.

Nous avons aussi examiné le fardeau que ces tragédies humaines imposent sur l'économie ontarienne. Toujours selon les données de recherches SAUVE-QUI-PENSE, les coûts directs des blessures routières en Ontario se chiffraient à \$125.4 millions en 1996 et les coûts indirects, à \$441.7 million, ce qui fait un total de \$567.1 million. Ce montant total représente 19.2% du coût total des blessures non-intentionnelles pour la province en cette année, suivant le coût dû aux chutes, coût évalué à 43.5% du coût total des blessures non-intentionnelles en 1996.

***Transport 2000 Ontario***  
**Traumatismes Vertébraux et Cérébraux Suite aux Collisions Routières:**  
**Coûts Humains et Economiques**

Bien que le coût total de ces blessures soit de l'ordre de la moitié du coût économique dû à la pollution (coût évalué à \$1 milliard par Ontario Medical Association), aucune donnée financière ne peut vraiment parvenir à refléter les pertes tragiques et évitables, ainsi que les douleurs et souffrances ainsi imposés, souvent en permanence, aux victimes de blessures vertébrales et cérébrales. On illustre dans ce compte-rendu certaines de ces victimes comme instances représentatives.

Nous nous concentrerons ici sur deux types principaux de blessures routières: les blessures vertébrales et les blessures cérébrales.

Puisque les blessures vertébrales affectent préférentiellement les jeunes, les coûts durant la durée de vie totale pour les soins médicaux, ainsi que les pertes de revenu individuel, peuvent facilement se chiffrer à \$5 millions dans chaque cas. Les collisions routières (voitures et motocyclettes) sont la cause principale de ces blessures, 42.8% selon le groupe de recherches de Queen's University, et 54.7% selon l'Association Canadienne des Paraplégiques.

Nous avons inclus le profil de deux de ces individus blessés dans des incidents routiers. Anita Kaiser est confinée à une chaise roulante, la moitié de son corps étant paralysé. Ses blessures sont la conséquence de l'éclatement d'un pneu, ce qui entraîna la perte de contrôle du véhicule dont elle était passagère. Richard (nom de plume) était auparavant un chauffeur de camion qui ne peut plus maintenant supporter sa famille après que sa voiture fut happée de côté par un second véhicule. Bien qu'il ait quelque mobilité, il souffre en permanence d'une grande douleur suite aux dommages vertébraux infligés.

Le traumatisme cérébral léger est un terme relatif utilisé pour contraster avec le traumatisme cérébral moyen ou aigu. Le terme en soi peut parfois contribuer à sous-estimer la sévérité du problème; en effet, ce genre de blessures peut souvent laisser des déficits mentaux permanents qui peuvent affecter le processus mental et le comportement des victimes.

Ce type de traumatisme se produit lors d'un impact sur le crâne. Aux Etats-Unis, 50% de tous les cas de telles instances sont le résultat d'accidents routiers. Compte-tenu du fait que les secteurs du cerveau ainsi affectés sont généralement aussi responsable des fonctions cognitives supérieures, les capacités de planification et d'organisation, ainsi que la résolution de problèmes et l'attention sélective sont adversément affectées. Il en est de même pour ce qui est de la personnalité ainsi que du comportement. Par conséquent, pour ceux ainsi affectés, la capacité de fonctionner "normalement" en société est sérieusement compromise. De plus, ces gens sont aussi fréquemment victimes d'anxiété, de dépression et de douleurs physiques.

Anne et Zoé (noms de plume) sont deux exemples de victimes de traumatismes cérébraux légers, suite à des incidents routiers, et leur cas est discuté dans ce compte-rendu. Toutes deux souffrent de façon chronique (i.e. à long terme) de troubles déficitaires émotionnels et de douleurs. Anne, de plus, souffre de déficits cognitifs. Ces deux femmes ne peuvent plus

***Transport 2000 Ontario***  
**Traumatismes Vertébraux et Cérébraux Suite aux Collisions Routières:**  
**Coûts Humains et Economiques**

avoir un emploi rémunéré. De plus, leur abileté à faire de simples tâches domestiques est grandement limitée.

Il existe deux façons de réduire le taux de blessures et de mortalités sur nos routes. La première de ces façons est d'accroître la sécurité des conducteurs. Ceci est déjà fait raisonnablement bien par le Ministère (Ontarien) des Transports. En l'an 2000, ce Ministère dépensa \$151,534,838 sur un tel programme. Cependant, ces efforts axés sur la prudence au volant ne peuvent qu'avoir un effet limité, puisque la flotte ontarienne de voitures et de camions augmente à un taux rapide: 21.24% entre 1992 et 2002. En contraste, le taux d'augmentation de la population ontarienne durant cette même période fut de l'ordre de 13.3%.

La seconde de ces méthodes est de réduire le nombre de véhicules sur les routes en présentant les transports publics comme une alternative attrayante.

Le budget ontarien pour 2003 en cette rubrique indique bien l'importance, le peu d'importance devrait-on dire, accordée aux transports publics. Ce budget spécifie \$1,055 millions pour les domaines routiers (planning, expansion et rehabilitation), mais un maigre \$359 millions en termes d'assistance au transit, soit *grosso modo* le tiers.

Spécifiquement, le gouvernement ontarien devrait:

- Legislate Légiférer, dans la Loi sur le Planning, une fin au développement expansioniste, ce facteur étant une cause principale de la dépendance sur le voiturage.
- Amender la Loi sur le Planning afin d'exiger que le planning dans chaque municipalités soit consistant avec les politiques provinciales de planning.
- Contibuer à réduire l'utilisation routière en initiant un moratorium sur l'expansion des routes, aussi bien exiatantes que projetées, sauf dans le cas d'exception légitimes.
- Réinstaurer un financement stable à long terme pour les transports publics.
- Entamer un processus de conception d'un système de transport inter-cité rail/autobus afin d'élargir le présent système de transit de façon à réduire la dépendance sur l'automobile.
- Encourager le transport du freight par rail.

(On trouvera en Conclusion une liste plus détaillée de ces recommandations).

This page left intentionally blank.

***Transport 2000 Ontario***  
**Spine and Brain Injuries from Vehicle Crashes: The Human and Economic Cost**

**I. INTRODUCTION**

Our purpose in producing this report is to raise the issue of the personal price that Ontarians pay for a transportation system based on private car and truck transportation in terms of injuries and fatalities. We also document the burden of those human tragedies on the Ontario economy.

The attitude of Ontario's politicians and bureaucrats towards transportation is curiously ambivalent. On the one hand, they place a high priority on safety. In the year 2000, they spent \$151,534,838 on a program called Road User Safety (Ontario Ministry of Finance, 2000). On the other hand, they continue to expand the most dangerous of travel modes, roads and highways, while allocating a fraction of the transportation budget to the safest mode, public transit. The 2003 Ontario budget provides for \$1,055 million in highway planning, expansion and rehabilitation, but only roughly one-third of this amount, \$359 million, in "transit assistance."

Unfortunately, Ontario's travelling public, which includes almost everyone, reflects this ambivalence to a great extent. It pays lip service to safety, while flocking in droves to car dealerships to purchase record numbers of vehicles, with a preference for those rollover champions, SUV's. However, one can hardly blame the travelling public for its preference for cars over transit, since road building and urban sprawl make public transit inefficient except in high-density urban cores.

So Ontario has a dysfunctional transportation system. We are car and truck dependent because we build roads and encourage urban sprawl; we build roads, which encourage urban sprawl because we are car and truck dependent.

Ontarians pay a huge price for this dysfunction both in human lives and in dollars. In fact, the medical care and other economic costs paid for by OHIP, insurance companies (although it must be noted their reluctance to pay results in frequent court cases), and individuals constitute a subsidy to the road system. If those costs were charged against the road system, as they would be in any accounting system other than a government's, our politicians and bureaucrats would quickly start looking at safer alternatives.

As long as the Ontario Ministry of Transportation follows a "business as usual" scenario, the travelling public and shippers see limited alternatives to car and truck dependency. Although a decline in collisions in 2001 from the previous year may be soothing, the 2001 figures still exceeded that of all the other years since 1990. To give credit where it is due, the enforcement of seat belt legislation, better engineered vehicles, and safety-related reminders on highways have had an impact. However, *safer* driving conditions will never become *safe* driving conditions. Drivers are fallible, vehicles are just machines that can and do break down unexpectedly, and weather cannot be controlled.

***Transport 2000 Ontario***  
**Spine and Brain Injuries from Vehicle Crashes: The Human and Economic Cost**

In absolute numbers, the human toll from vehicle crashes is enormous. There were 845 fatalities and 81,782 injuries on Ontario's municipal and provincial roads in 2001 (OMOT, 2001: Section 1, Synopsis, p. 12). Because many Ontarians do not see any alternative to driving, these tragic losses are met with a conspiracy of silence. We prefer not to think about the economic cost either. In a sobering study published by the Ontario Ministry of Transportation (Vodden, et al., 1994), entitled *The Social Cost of Motor Vehicle Crashes in Ontario*, the authors estimated that crashes in 1990 cost individuals, organizations, and governments in Ontario \$9 billion. The cost included health-care costs, property damage, police, insurance, and lost earnings. The study caused barely a ripple.

Transport 2000 Ontario believes that the time has come to face the unpleasant facts about Ontario's transportation system. The new government at Queen's Park should take a hard look at the outmoded transportation policy of predict and provide (roads). We hope that this report on some of the ignored but real costs of our car and road dependence will be a stimulus for a new approach that provides more extensive alternative forms of mobility in urban areas and across the province.

*The Human Cost.* We will examine two principal types of road crash victims, those who suffered spinal injuries, and those who suffered mild traumatic brain injuries. We will look at them as real people – rather than statistics – including their symptoms, treatment, and their challenges, pain and suffering.

The very substantial healthcare burden produced by vehicle emissions has been dealt with by others and will not be covered in this report. However, it is useful for purposes of perspective to note that the Ontario Medical Association estimated that, in the year 2000, pollution costs to the healthcare system, and losses to employers and employees, was over \$1 billion. If the value of pain and suffering and loss of life are added, the total annual economic loss was \$10 billion in the year 2000, rising to an estimated \$12 billion by the year 2015 (OMA, 2000: Scenario 1). Road vehicles contributed a substantial portion of that \$1 billion estimate. The Ontario Ministry of the Environment has calculated the contribution of components of air pollution by motor vehicles as follows: volatile organic compounds, 19%; nitrogen oxides, 35%; and carbon monoxide, 45% (OMOE, 2000: 10, 21, 23). Walter Chan of the Ontario Ministry of the Environment reported that vehicles contributed 10% of fine particulate matter to Ontario's polluted air (Chan, 2003: Slide 7, Ontario's Smog Emissions Profile, 2000).

*The Economic Cost.* Our report's economic cost of motor vehicle injuries will be based mainly on an in-depth report produced in 1999 by SMARTRISK entitled *The Economic Burden of Unintentional Injury in Ontario* (Albert and Cloutier, 1999). SMARTRISK is a national non-profit charitable organization dedicated to preventing injuries and saving lives.

*Transport 2000 Ontario*  
**Spine and Brain Injuries from Vehicle Crashes: The Human and Economic Cost**

The reader will notice that in this report the word “accident” is never used in the context of traffic injuries. The omission is deliberate and follows SMARTRISK’s practice. An accident is an event that is unexpected. Since collisions on our busy roads are inevitable, they are not accidents. The Canadian Desk Dictionary defines the word as, “Any circumstance or attribute that is not essential to the nature of something.” According to SMARTRISK, “...injuries are not accidental events. They are predictable: the risk factors are identifiable, and there are preventive interventions available that can minimize their impacts. Injury prevention must therefore be considered an investment” (Albert and Cloutier, 1999: 1-2).

## II. ECONOMIC COSTS

Before examining the human cost of two major kinds of auto crash injuries – spinal injury and mild traumatic brain injury (MTBI) – it is useful to provide an overall context. The most recent assessment of the economic costs of motor vehicle crashes in Ontario is the 1999 study by SMARTRISK in co-operation with the Ontario Ministry of Health and Long Term Care, and others. Entitled *The Economic Burden of Unintentional Injury in Ontario* (Albert and Cloutier, 1999), this study is based on 1996 data for Ontario (adapted from a national study by Angus, et al., 1998). SMARTRISK defines motor vehicles as all type of cars, trucks and motorcycles that operate in traffic. Their use of the term “unintentional injuries” distinguishes these kinds of injuries from injuries (including fatalities) caused by weapons, assaults, or suicides. Their division of injury costs into direct and indirect costs also needs some explanation. Direct costs are the total of all goods and services used for diagnosis and treatment such as medications, prostheses, services of health care providers, hospitalization, and rehabilitation. Indirect costs reflect lost productivity due to time away from a major activity (paid employment and home making, for instance). It also reflects lost productivity due to premature death. Lost productivity represents the losses of goods and services that are not produced as a result of the injury either by being off work or from not being as productive as one once was.

According to SMARTRISK, there are two additional types of cost that are difficult to quantify and, while important, are therefore not included as economic costs. The first is other expenditures which patients and families must bear as a result of injuries such as increased transportation costs, litigation costs, items for rehabilitation, home refits such as ramps, special diets and clothing. The second category has to do with quality of life. It includes pain and suffering, social isolation, emotional problems, disability, lower academic attainment and decreased employment prospects. Since these two categories are not quantified in the SMARTRISK study, the quantified data must be viewed as conservative.

SMARTRISK has taken the position that transfer payments such as Canada Pension Plan, disability payments, and social assistance are not considered costs since they are a reallocation of resources and the net effect of the transfer to society is zero. Transport 2000 takes the position that whatever sector covers the costs of injury, government, insurance, the

***Transport 2000 Ontario***  
**Spine and Brain Injuries from Vehicle Crashes: The Human and Economic Cost**

individual or family, the cost is an economic burden to Ontario society and represents resources that could be deployed productively elsewhere.

With respect to unintentional injuries in Ontario, SMARTRISK's study reports injuries, deaths due to injuries, hospitalization or non-hospitalization due to injuries, and partial or total permanent disability due to injuries by major cause categories. These categories include motor vehicle crashes, falls, poisoning, drowning and suffocation, fires, water transport, air and space, railway, pedal cycle, and a residual category "other" that includes motor vehicle non-traffic, natural and environmental, and recreational and other incidents categories.

Table 1 below summarizes the 1996 data on unintentional injuries for Ontario. The mortality and hospitalization data are based on nationally collected Canadian data. However, data regarding disability and non-hospitalization incidents of injury have been mainly estimated based on a major comprehensive U.S. study.

Table 1. Frequencies of unintentional injuries, Ontario, 1996.

	Unintentional injuries resulting in:				
	(1)	(2)	(3)	(4)	(5)
Major cause category:	Death	Hospitalization	Non-hospitalization	Partial permanent disability	Total permanent disability
Motor vehicle	1,110 (39.0%)	3,474 (8.0%)	68,291 (9.8%)	1,072 (7.0%)	128 (11.2%)
Falls	991 (34.8%)	27,289 (62.9%)	301,119 (43.4%)	9,907 (65.0%)	723 (63.4%)
Poisoning	263 (9.2%)	1,649 (3.8%)	19,259 (2.8%)	358 (2.4%)	11 (1.0%)
Drowning and suffocation	105 (3.7%)	111 (0.3%)	885 (0.1%)	23 (0.2%)	10 (0.9%)
Fires	100 (3.5%)	173 (0.4%)	3,834 (0.6%)	86 (0.6%)	4 (0.4%)
Pedal cycle	1	839 (1.9%)	9,585 (1.4%)	279 (1.8%)	26 (2.3%)
Other	274 (9.6%)	9,847 (22.7%)	290,658 (41.9%)	3,505 (23.0%)	237 (20.8%)
Total	2,844 (100.0%)	43,382 (100.0%)	693,631 (100.0%)	15,231 (100.0%)	1,140 (100.0%)

Note: Based on Tables 2 - 5 in Albert and Cloutier (1999). Totals subject to rounding error.

Of the causes of injuries reported in Table 1, falls are the most frequent, followed by motor vehicle crashes. In the case of deaths, frequency is higher for motor vehicle crashes than for falls. Taking hospitalization and non-hospitalization together as representing a total annual incidence of a type of injury, a rough calculation of a mortality rate can be made (our calculation, not SMARTRISK's). Thus motor vehicle crashes in 1996 led to 15.5 deaths per 1,000 incidents compared to only 3 deaths per 1,000 incidents for falls, roughly a five-to-one ratio, a clear indication of the more lethal nature of motor vehicle crashes in general. Similar calculations show that the rate of partial permanent disability from falls is roughly twice the

## *Transport 2000 Ontario*

### **Spine and Brain Injuries from Vehicle Crashes: The Human and Economic Cost**

rate for motor vehicle crashes, with the total permanent disability rate being about the same for falls and motor vehicle crashes.

The Ontario Ministry of Transportation's annual road safety report for 2001 provides data on fatalities and injuries by ten-year age groups (with the 16-24 year age group being nine years long). From this data we see that fatalities of drivers are high for the age groups between 16 and 54, rising again for the 75 plus age group. Driver and passenger fatalities are highest for the 16-24 year age group, with passenger deaths dropping off and remaining at a relatively constant level beginning with age 25. For driver injuries, frequencies are high for the age groups between 16 and 44, declining in frequencies thereafter; for passenger injuries, frequencies are high for the age groups between 16 and 34, declining thereafter. These numbers highlight the preponderance of young and middle-aged drivers and passengers in motor vehicle crashes, people in their most productive years. Within an age grouping, the higher frequencies of fatalities and injuries for drivers as compared to passengers partly indicates the predominance of car and truck use with a single occupant, this occupant of course being the driver (OMOT, 2001: Tables 2.2 and 2.3).

According to SMARTRISK's research, the direct cost of motor vehicle injuries in Ontario in 1996 was \$125.4 million and the indirect costs were \$441.7 million, for a total of \$567.1 million (Albert and Cloutier, 1999: 27). SMARTRISK calculated that this total of \$567.1 million represents 19.2% of the total unintentional injury costs for the province in that year (\$2,947.6 million), second to falls which had 43.5% of the total unintentional injury costs in 1996 (p. 28). Particularly startling in Table 2 is the very high mortality costs of motor vehicle crashes in Ontario, largely due to the younger ages of these victims giving rise to large estimated future productivity losses. As context, SMARTRISK reports that "Nationally, injury ranks third behind cardiovascular and musculoskeletal disease in terms of societal economic burden (p. 1)," referring to a 1997 study by Health Canada.

Calculating the economic costs of unintentional injuries is important in two respects. Firstly it forces consideration of the full extent of costs many of which are unseen and unacknowledged but nonetheless very real for individuals and society. Secondly, it makes possible another calculation: the relative costs and benefits of public policy responses. With an understanding of the components of the costs of unintentional injuries, it is possible to estimate the costs and benefits of implementing specific programs aimed at reducing the occurrence of injuries in the first place.<sup>a</sup> The Ontario SMARTRISK study poses goals such as reducing various kinds of fatalities and injuries, and indicates a variety of control objectives with target percentage reductions and time frames. With the detailed economic data in hand, it is possible to demonstrate net savings to society of programs that, for

---

<sup>1</sup> These attempts at calculation also establish the need for better and more comprehensive data collection on injuries in Canada. In both their national and Ontario studies, SMARTRISK had to rely on some U.S. research and cost models in the absence of adequate Canadian data.

***Transport 2000 Ontario***  
**Spine and Brain Injuries from Vehicle Crashes: The Human and Economic Cost**

Table 2. Direct and Indirect Costs (\$ Millions) Resulting from Unintentional Injury, Ontario 1996.

Expenditure category:	Injury category:			
	Motor vehicle	Falls	Other	Total
<i>Direct costs</i>				
Hospitalized cases				
Hospital	12.4	141.5	33.3	187.3
Medical	10.8	109.2	26.1	146.0
Rehabilitation	0.8	7.2	2.2	10.2
Sub-total	24.0	257.9	61.6	343.5
Hon-hospitalized cases				
Medical	15.8	125.5	82.8	224.1
Rehabilitation	1.0	8.4	5.6	15.2
Sub-total	16.8	133.9	88.5	239.3
Permanent disability	84.6	479.7	316.5	880.7
<b>Total direct costs</b>	<b>125.4</b>	<b>871.4</b>	<b>466.6</b>	<b>1463.5</b>
<i>Indirect costs</i>				
Morbidity costs				
Cases while hospitalized	0.6	1.9	1.1	3.6
Partial permanently disabled	62.7	255.8	293.5	611.9
Total permanently disabled	45.1	125.3	108.4	278.9
Sub-total	108.4	383.0	403.0	894.4
Mortality costs	333.3	28.4	227.9	589.7
<b>Total indirect costs</b>	<b>441.7</b>	<b>411.3</b>	<b>631.0</b>	<b>1484.1</b>
<b>Total costs</b>	<b>567.1</b>	<b>1282.8</b>	<b>1097.7</b>	<b>2947.6</b>

Note: Based on Tables 6-8 in Albert and Cloutier (1999). Totals subject to rounding error.

example, reduce highway speeds, install more flashing lights at railway crossings, increase the use of bicycle helmets, etc.

While we do not have the resources to undertake detailed cost/benefit calculations following the model of SMARTRISK, we believe that substantial public and human benefits would flow from a modal shift away from the use of private cars for mobility towards the use of public transport and non-motorized transportation (walking, cycling). We are sustained in this belief by the significantly low numbers of passenger fatalities and passengers injured on all forms of public transport. The number of passenger fatalities and serious injuries on forms of public transport – be it air travel, passenger trains, intercity buses, commuter rail, marine, and urban transit – is so low that any serious injury or fatality of passengers usually brings on the special attention of the media. In 2001, buses (not including school buses) in

<sup>2</sup> Statistics on transportation fatalities and injuries by mode of transport are published annually by Transport Canada (2002). Rates of fatality and injury by transport mode highlighting the outstanding safety record of public transport, and of urban transit in particular, may be found in Briggs and Levy (2000); some data from this report is to be found in the Addendum.

## *Transport 2000 Ontario*

### **Spine and Brain Injuries from Vehicle Crashes: The Human and Economic Cost**

Ontario were involved in 13 fatalities and 624 injuries, railway trains were involved in 9 fatalities and 23 injuries, streetcars, in one fatality and 90 injuries, and bicycles in 17 fatalities and 2,676 injuries (OMOT 2001: Table 5a). In contrast, the day-in and day-out deaths and injuries on our highways even in the aggregate do not raise the obvious designation of being an epidemic.

As already indicated, motor vehicle crashes cost Ontario over a half-billion dollars in 1996. In one scenario developed by SMARTRISK reducing drinking and driving by 20%, reducing speed limits, and road improvements in design and maintenance may lower this economic cost by as much as \$180 million annually in net savings.<sup>3</sup> However, no dollar figure can truly reflect the tragic and preventable loss as well as pain and suffering experienced by spine injured and brain injured victims, cases of which are profiled next in this report.

### **III. SPINE INJURIES**

A spinal cord injury occurs when the cord itself is crushed, stretched or torn. According to a Queen's University research group, 42.8% of spinal cord injuries are caused by motor vehicle crashes (EMIRG, 2003).<sup>4</sup> Research by the Canadian Paraplegic Association (CPA) has determined that car and motorcycle crashes are the leading cause of spinal cord injuries at 54.7% of all causes (CPA, 2000). Statistics vary, but whichever statistic is used, the fact remains that motor vehicles are responsible for a significant number of spinal cord injuries.

The CPA reports that most spinal cord injuries are experienced by young people, with 78% of those injured being between the ages of 15 and 34; the majority of victims are also male. In addition, there is a disturbing trend toward more severe injuries in Canada. In the 1970's, about 25% of severe spinal injuries resulted in quadriplegia, paralysis of all four extremities, and 75% in paraplegia, paralysis of the trunk and lower limbs. Of the injuries reported to the CPA in 1999, 47% resulted in quadriplegia, and 53% resulted in paraplegia (CPA, 2000).

Since spinal injury affects the young, the lifetime cost for medical and rehabilitation treatment and lost earnings can be as high as \$5 million for an affected person.<sup>5</sup> Part of that treatment involves the difficult task of identifying the various types of pain that accompany

---

<sup>3</sup> We refer here to SMARTRISK's "Scenario 3: Reduction in Motor Vehicle Crashes" which bases its net cost savings on projections of some 380 fewer deaths, 900 fewer hospitalizations, 6,400 fewer non-hospitalized injuries, and "almost 250 fewer injuries resulting in some form of permanent disability" (Albert and Cloutier, 1999: 63) annually that would result from its proposed actions. While the cost of vehicle injuries is substantial by any measure, as pointed out earlier, it is a little more than half of the economic cost of pollution impacts on health – \$1 billion as calculated by the Ontario Medical Association (OMA, June, 2000, Scenario 1).

<sup>4</sup> Queen's University's Emergency Medicine and Injury Research Group follows the International Classification of Diseases which defines transport incidents as including all on-road and off-road vehicles and bicycles.

<sup>5</sup> Information provided by Dr. Charles H. Tator in communications with the authors June 23, 2003 and July 9, 2003.

## *Transport 2000 Ontario*

### **Spine and Brain Injuries from Vehicle Crashes: The Human and Economic Cost**

spinal cord injury and prescribing the appropriate medication, since severe pain is a frequent accompaniment of spinal cord injury. In some patients, pain may become the most debilitating effect of the injury (Tator, n.d.).

The trend towards more severe injuries means greater difficulties for persons with spinal injuries finding and holding on to employment. Furthermore, according to the (U.S.) National Spinal Cord Injury Database (NSCID), because of the youthful age of most persons with spinal injury, most (53%) are single when injured. Among those who are married at the time of the injury, as well as those who marry later, the prospect of a marriage remaining intact is slightly lower when compared to the uninjured population. In other words, a significant number of individuals who suffer spinal cord injuries are poorer and more socially isolated than the uninjured population (NSCID, 2001).

The following vignette is a profile of a young quadriplegic who volunteered to be interviewed for this report.

*Anita Kaiser's story.* In September of 1996, Anita and her sister were returning by car to Toronto from a weekend in North Bay. Anita had recently received her undergraduate degree from university and was employed in the computer field. She had plans to resume her studies in a physiotherapy program. They were travelling in a well-maintained car, were wearing seatbelts, and no alcohol had been consumed. After a while, they smelled burning rubber and pulled into the nearest gas station. The attendant checked their tires and reported that one front tire had a low tread. He advised that they could continue to drive home, but recommended that the tire be changed when they arrived. About ten minutes later, her sister, the driver, tried to overtake a slow-moving truck. As she changed lanes at 100 to 110 kilometres per hour, the tire blew and she lost control. The car zigzagged across the highway, went off the left shoulder, and rolled side over side five times down a steep hill. Anita blacked out and remembers nothing of the incident. Her sister suffered minor cuts and bruises.

The sisters were transferred to Huntsville Hospital from which Anita was flown by air ambulance to the Regional Trauma Centre at Sunnybrook and Women's College Health Sciences Centre. She was immediately placed in a halo that holds a patient motionless from waist to top of head in order to realign her broken neck. After an MRI, a CT scan, and various X-rays, it was determined that the spinal disc between two vertebrae in her neck had burst and the vertebrae were fractured. Fragments of the vertebrae had pierced the spinal cord. At the age of 24, Anita had become a C6-C7 quadriplegic. The "C" indicates the cervical (highest) segment of the spinal column and "6" and "7" refer to the vertebrae numbers starting from the top of the spine. The higher in the spinal column the injury, the greater the injury, since higher injuries paralyze more of the body. Anita spent six weeks at Sunnybrook, three in intensive care after surgery to repair her broken vertebrae.

## *Transport 2000 Ontario*

### **Spine and Brain Injuries from Vehicle Crashes: The Human and Economic Cost**

Anita was then transferred to the Toronto Rehabilitation Institute's Lyndhurst Centre where, in the course of one year, she received physiotherapy to help her adapt to life in a wheelchair, and occupational therapy to attempt to relearn fine motor skills like feeding herself and writing. She also had to learn to attend to new body signals due to the disruption in the autonomic nervous system that previously had looked after bodily functions.

After high quality and expensive hospital care and a course of rehabilitation, Anita has the use of half of her body. She has partial sensation in her arms, limited use of her hands, and no movement or sensation from her chest down. Because she can breathe only with her diaphragm and not with her chest wall, her breathing capacity has been reduced by half.

Her daily life is arduous: simple tasks like washing and dressing consume a great deal of time and energy. She has to deal with an inaccessible community. A specially equipped van enables her to drive, but normal parking spaces for the disabled are too small to accommodate her van with its special wheelchair lift. Grocery and general shopping are frustrating and tiring. She participates in sports for the disabled, but has not yet found activities she can share with her able-bodied husband and friends.

In spite of the huge physical hurdles that she must now live with, Anita is a poster girl for the spinal cord injured. She is well educated, attractive, and has a solid network of support. She was married three years ago, and lives with her husband in a house refitted to suit her needs – a costly process paid for by car insurance. She presently volunteers as a researcher at the Lyndhurst Centre. While an upbeat story like Anita's is not unique, she is not typical of spine injury victims. Many paraplegics and quadriplegics do not enjoy as good a quality of life. One has to wonder how many of these broken bodies would be whole if they had been traveling on a train, bus, or by public transit.

*Richard's Story.* Richard represents one of the spine injured population's "walking wounded." His injury is to his spinal column but not to his spinal cord and he is not confined to a wheelchair. Richard (not his real name) is a middle-aged former truck driver who lives in a mid-sized Ontario city. He was earning \$50,000 a year four years ago when he sustained his injury. It was mid-afternoon on a dry day when Richard was taken by surprise by a vehicle that suddenly pulled out of a plaza directly into his path. Richard was wearing his seatbelt, his car was in good condition, no alcohol was involved, and he was traveling at the speed limit. Richard felt no immediate physical effects. He was able to exit his car, walk around to inspect the damage, speak to the other driver, report to the police and drive his car home. Passers-by would not have suspected that anyone was hurt in that collision.

However, he soon began to experience physical symptoms. He was stricken by nausea, numbness in his feet, and spasms in his shoulders and neck. The symptoms became unbearable when he returned to driving a truck. He took Tylenol 3 for pain and Cyclocenzaprine to reduce spasms to help him sleep. He had no choice but to give up the work he enjoyed.

**Spine and Brain Injuries from Vehicle Crashes: The Human and Economic Cost**

His wife, who had stayed home to look after their young children, was forced to return to work. Richard took over the care of the children and performed as many household chores as his nausea and pain allowed. He was able to drive his car for limited periods, but after 40 minutes the numbing returned.

Seeking medical treatment was frustrating and the results variable. The wait to see an orthopedic surgeon was over a year, and since his insurance benefits could be cut off after two years, he sought out doctors in other specialties. In addition to MRI and CT scans, he had an EMG test for nerve damage. One physician was able to give him short-term relief from his nausea, but it then returned. He underwent spinal surgery, a fusing of his spine called a “caging technique” in which two steel rods were inserted into his back. This technique allows him to sleep more comfortably, but his nausea and numbing still prevent him from working full time at any physical job. Richard has explored alternative occupations, but he has a limited education and a limited sitting and standing tolerance.

Richard’s family income now consists of his wife’s salary as a secretary and income replacement from his automobile collision insurance. The latter was capped at \$400 a week, the maximum permitted by law at the time of his injury and approximately half of his former income. He is suing the driver of the other vehicle for income loss but is restricted to 80% of his net income from former employment until the case is settled or goes to judgment. However, his case will not go to trial for another year. Even though he was not at fault, he will never recover the other 20% of his net income. The family has been forced to dip deeply into retirement savings to save their home and try to make ends meet.

Richard was an active father who engaged in sports and outdoor activities with his children and with children in the community as a coach. He is no longer able to participate in these activities – a serious loss to him and his family. Richard has put in a claim against the at-fault driver, asking his/her insurance company to make a payment for reduced care, guidance and companionship of his children who are under the age of ten.

Richard’s life course plans are now stalled. His standard of living and the quality of his life and that of his family are severely reduced because of the momentary inadvertence of a driver who pulled out into the road and into his path.

**IV. MILD TRAUMATIC BRAIN INJURY (MTBI)**

MTBI is a relative term used to distinguish it from moderate or severe acquired brain injury. To put MTBI in context, it might be helpful to briefly describe the symptoms of the more severe types of acquired brain injury. The term “acquired” refers to injury not present at birth.

**Spine and Brain Injuries from Vehicle Crashes: The Human and Economic Cost**

Moderate and severe acquired brain injuries involve coma of varying duration. The Glasgow Coma Scale is used as a tool to measure the severity of brain injury. This scale has been modified in the form of the Glasgow Outcome Scale (Hamilton Health Sciences Corporation, n.d.) to describe the level of disability from acquired brain injuries.

The most severe brain injuries result in death or a persistent vegetative state. Lower on the scale is severe disability in which the individual is conscious but disabled. That individual is dependent for daily support by reason of mental or physical disability, usually a combination of both. Next is moderate disability, which describes an individual who is somewhat independent. S/he can spend some time alone but requires help. The person is capable of traveling by public transport and working in a sheltered environment.

Mild traumatic brain injury is associated with a transient disturbance of consciousness such as a disoriented or dazed episode, or a temporary loss of consciousness. Many victims recover without any apparent long-term effects, but for the unlucky ones, the long-term effects may be devastating.

MTBI is caused by a blow to the head by an outside force, or by a violent head movement such as whiplash in a motor vehicle collision. In the latter case, the injury is caused by acceleration of the vehicle followed by rapid deceleration causing the forward or backward moving head to come to a sudden stop. The skull is not penetrated and the motion may or may not include striking a stationary object. The floating brain keeps moving in the skull until it makes forceful contact with the front of the skull bruising the frontal and temporal lobes of the brain. The victim may or may not remember the incident.

The front of the skull houses the frontal and temporal lobes which are responsible for the higher cognitive functions and problem solving, selective attention, planning, organizing, short term memory, as well as behaviour and emotions. An injury to this part of the brain, unless the individual recovers spontaneously, alters the personality and leaves deficits that may be permanent. Complicating the situation is the fact that MTBI is invisible to the casual observer. As a result, many victims go undiagnosed, or are diagnosed later when they return to work or school and find that they cannot perform as they did previously.

The changes in the brain, called postconcussive syndrome, can be many and wide-ranging. In the United States, half of MTBI victims develop postconcussive syndrome (Goetz and Pappert, 1999: 1040). Some changes are subtle, such as a loss of intellectual sharpness and a decrease of sensitivity in interpersonal relations, both of which can have serious consequences for the victim. The more obvious symptoms in more severe cases include some or many of the following symptoms: Judgement and decision-making abilities are impaired, and the individual cannot organize tasks in a coherent way. Emotional lability (excessive emotionalism) causes extreme reactions, out of proportion to the triggering event. The individual is distractible and learning is problematic. Academic achievement is lower and as a result, employment prospects are fewer. Physical pain and anxiety aggravate an already

**Spine and Brain Injuries from Vehicle Crashes: The Human and Economic Cost**

stressful existence. Physical problems include pain, headaches, fatigue, difficulties with balance and hand coordination, and sexual dysfunction. The individual requires the services of a neuropsychologist or neuropsychiatrist. The sum total of all these life changes is depression, disturbed sleep, social isolation and poverty.

In the United States, half of all degrees of traumatic brain injuries are the result of motor vehicle crashes (Stoler and Hill, 1998: 10). No comparable statistics for traumatic brain injuries are available for Canada, but it is safe to assume that the data would be similar.

The following profiles of two MTBI victims illustrate the grim outcomes from seemingly routine vehicle collisions.

*Anne's story.* Anne (not her real name) is a MTBI victim who agreed, with her lawyer's approval, to be interviewed for this report. The lawyer was present at the interview. Anne, who lives in a medium size city in Ontario, is a 54-year old divorced mother of two adult children. Prior to her injury, she earned \$26,000 a year as an executive secretary in a real estate office. She had a stable relationship with her boyfriend, enjoyed travel, had a circle of friends, and was generally satisfied with her life.

In November of 1995, Anne and her boyfriend, who was at the wheel, were on their way to Costco when they encountered a traffic jam caused by a stretch of black ice on a bridge. The driver decided to turn the car around and head back, and in the process blocked an approaching vehicle that struck them. Anne's head hit the door but she did not lose consciousness. However, she remembers nothing of the collision, a situation so typical that it has been given the name, "post traumatic amnesia." An ambulance arrived on the scene, and after applying an ice pack to her head, the attendant told her to return home and go to the hospital only if she felt ill.

She woke up the next morning with a severe headache accompanied by nausea, vomiting and in pain. In the emergency department of a local hospital she was tested to determine the source of pain in her neck, right shoulder, hip and lower back. She was sent home with instructions to have someone wake her every two hours during the night.

Subsequently, Anne went to see a neuropsychologist. After another series of tests, she was diagnosed as having a brain injury. She was put on medication, received physiotherapy and psychotherapy, and was sent to an acquired brain injury clinic. She received speech therapy from a speech and language pathologist and further help from a rehabilitation therapist.

Her condition improved somewhat, but, after two years of treatment it was determined that, except for home help from a rehabilitation therapist, nothing more could be done for her. Anne lives in a modest house purchased with the proceeds of a settlement obtained after a hard-fought court case, and receives a small monthly allowance after litigation against the insurance company that was to have provided her with her "accident benefits." (Her

## *Transport 2000 Ontario*

### **Spine and Brain Injuries from Vehicle Crashes: The Human and Economic Cost**

boyfriend and the other driver were both found at fault.) Her relationship with her boyfriend fell apart and she has no social life. Because of her inability to focus, daily chores are frustrating and time consuming. She forgets her list when she shops and buys the wrong groceries. She spends an inordinate amount of time looking for “lost” items around the house. Her children, she explained, have “busy lives” and help her a little, but “they don’t understand.” Returning to work is out of the question since she “...can’t read, can’t count, and can’t concentrate.” Asked how she views her future, Anne sees only more of the same as a result of a brief incident in 1995 that has “ruined my life.”

*Zoe’s story.* Zoe (not her real name) was interviewed in the presence of her primary physician. Zoe, a 34-year old mother, lives in a small Central Ontario city. She sustained her injury while driving her mother and baby daughter on some errands during a snowstorm in January, 1999. As she slowly travelled along a main thoroughfare, a car, “t-boned” her vehicle on the passenger side as it skidded exiting a plaza. Her mother, the passenger, was not hurt, and the baby in the infant seat in the rear, slept through the incident. On impact, Zoe’s head, shoulder and left side hit the window and frame. She remained conscious and remembers the details of the collision. She drove to the nearest collision-reporting office to make a report and then made her way home. Five months after this collision, Zoe was rear-ended in a second collision that caused an exacerbation of her physical condition. Repeated traumas produce a multiplier effect on an original trauma to the brain.

At the time of her original injury, Zoe was on maternity leave from her current employment, but was searching for a new job. She had been a successful Jill-of-all-trades, mostly clerical. She stated that she was well regarded as an employee and in her job search had been invited back for second interviews. Her husband is a fabricator in an aluminum plant where he earns about \$30,000 a year.

As a result of her injuries, Zoe suffers from headaches, nausea, and debilitating pain in her neck and upper and lower back, the latter radiating down her left leg. She suffers from frontal lobe symptoms that are compatible with traumatic brain injury, but may also be the result of chronic pain. However, her thought processes remain intact. Symptoms include anxiety, emotional lability and irritability. Not surprisingly, her situation has left her frustrated and angry.

Formerly an active person, Zoe now cannot hold a normal job and is able to do only a minimum of housework. Even sedentary activities that she previously enjoyed such as crocheting and reading are problematic because her arms “go dead.” The pain is controlled with combinations of the following drugs: time-released morphine, Dilaudid, Ritalin, Cesamet, Topamax, Wellbutrin, and Hydromorph.con.

Zoe’s plans for the future are on hold. Her hopes for new employment, badly needed to help pay the bills, and for a second child are not achievable in her condition. And her doctors anticipate no improvement. Her hopes for adequate compensation from her insurance

*Transport 2000 Ontario*  
**Spine and Brain Injuries from Vehicle Crashes: The Human and Economic Cost**

company for pain and suffering are also dashed. Her lawyers sued for \$1.5 million and the insurance company settled for \$25,000. After paying her lawyers, she was left with \$13,000. Zoe was refused disability payments from the Ontario government who judged that her disability was not substantial enough. Her application to receive Canada Pension Plan is in process.

## V. CONCLUSION

Road crash victims who are severely injured disappear into hospitals and cemeteries and are rarely heard about again, other than perhaps some brief news coverage if the crash is deemed bad enough. In this report, we have attempted to give the victims a voice and end our collective denial about the hazards of car and truck dependency. We believe that a new government at Queen's Park provides an excellent opportunity to question the "business as usual" approach to road building and to make a commitment to a safe and sustainable transportation system in the province. We also hope that we have cast enough light on the true costs, both human and economic, that promising roads as a way to win votes is an election ploy that will be abandoned forever.

There are two ways to reduce injuries and deaths on our highways: The first, improving safety, gets serious attention by the Ontario government. The Ministry of Transportation is for the most part effective in improving driver education, and in engineering safer roads. However, these policies, while laudable and useful, will only make a small dent in the number of broken bodies and minds – the consequences of our car dependent system.

High numbers of deaths and injuries will continue for the following reasons:

- The number of cars on Ontario's roads is increasing at a great rate. In 1992, 7,398,287 road vehicle licences were issued; in 2002, that number increased to 8,969,828, an increase of 21% in ten years. By contrast, the rate of increase in the Ontario population in those years was 13.3%.
- The number of vehicle kilometres travelled between 1971 and 2000 increased by 87% while the population increased by 53% (OMOE, 2000: 8).
- Within Ontario's driver population are those who should not be behind a wheel. However, no test exists that can identify people who are psychologically unfit to drive.
- Withdrawing driving privileges from seniors whose skills have deteriorated is politically unpopular.
- Cell phones and other electronic distractions are increasingly considered essential as cars become second offices.
- Urban sprawl, the offspring of road building, creates a car-dependent lifestyle.

---

<sup>6</sup> These data, summaries of vehicle population by vehicle class, were provided in a communication to the authors in the form of a printout of annual counts as of December 31 by the Licensing Administration Office of the Ontario Ministry of Transportation.

## *Transport 2000 Ontario*

### **Spine and Brain Injuries from Vehicle Crashes: The Human and Economic Cost**

- Cars are machines that can break down unexpectedly, and weather cannot be controlled.
- In spite of our best efforts, drinking and driving appear to always be with us.

The second and equally important solution is simply to reduce the number of cars and trucks on our roads by offering safer alternatives. There are those of course who prefer to drive and those who must drive for business reasons. But many drive because they feel they have no choice, and there are many who would use transit more often if it was competitive with the automobile. A new transportation system should incorporate all modes, both rail-based and road-based, since cars and trucks have their place in a balanced system. However, in the interest of public health, safety and economy, government support must favour sustainable modes. (The argument that public transit and rail are subsidized and therefore are a burden to taxpayers is not valid since all forms of transportation are subsidized directly and/or indirectly.)

The alternative to cars is expanded public transportation. For cities and urbanized areas buses, light rail transit, and, where there is density, subways and commuter rail, are options. Passenger trains in particular can provide an alternative for regional and inter-regional transportation. Rural areas can also partake of rural transit initiatives.

Essential to public transportation is a new direction in urban planning. For transit to be cost effective, it must be supported by high density (not necessarily high rise) development and mixed-use neighbourhoods. Urban and rural sprawl are unnecessary. There is enough unused land in virtually all municipalities for expansion within urban boundaries. Expansion beyond those boundaries should take place in small, carefully planned increments only after urban intensification is underway.

To achieve an effective public transportation system in the province, the new provincial government should:

- Amend the Planning Act to require that planning in all municipalities be consistent with provincial planning policies. Those latter policies should adhere to the principles of compact, mixed-use development and the preservation of agricultural and ecologically sensitive areas. Most importantly, those policies must control the scourge of urban sprawl. Where development takes place, it should be transit-oriented. Decisions of the Ontario Municipal Board should be consistent with planning policies and should not overturn official plans as adopted by elected officials.
- Develop regional planning principles so that sprawl does not come to surround municipalities and come to rural areas by the actions of highway building, and highway upgrading and expansions.
- Initiate a moratorium on all road expansion with a very few strategic exceptions. Road building feeds on itself – adding road space does not relieve congestion, but invites new traffic. This is the phenomenon “The Black Hole Theory of Highway

## *Transport 2000 Ontario*

### **Spine and Brain Injuries from Vehicle Crashes: The Human and Economic Cost**

Construction” – traffic will fill any road space built. Particularly in southern Ontario the building spree now going on to double road space is a misplaced investment. With its mature road system, investment should now go to the alternatives mentioned above so that a balanced transportation system can be achieved for Ontario.

- Reinststate the pre-1998 Ontario government practice of financially supporting municipal transit’s operating and capital budgets and make that support stable and reliable. Generous support is essential to allow for expansion and to achieve first class transit systems – comfortable, attractive, accessible, frequent and reliable. A cut-rate or system on the cheap will not attract new riders (light rail will attract substantially greater ridership than busways, for example). Ontario’s transportation infrastructure has been largely developed with public funds. Subsidizing a public good like transit is a cost-effective use of tax dollars. The downloading of transportation infrastructure capital and operating costs for transit and roads needs correction through the provision of corresponding taxing power to municipalities, such as through a share of fuel taxes. Senior levels of government should also participate with municipalities in creating plans for improving public transit on a regional basis.
- Begin the process of designing a sustainable inter-city and commuter transportation system based on bus/train modes and provide financial support for the system.
- Shift greater amounts of freight movement to environmentally sustainable rail.

Ontario needs a safe, sustainable transportation system implemented by a progressive and enlightened provincial government. Unless this happens, our roads will continue to kill and maim too many in our population, many in their most productive years.

### **REFERENCES**

Albert, Terry and Eden Cloutier (1999), *The Economic Burden of Unintentional Injury in Ontario*, SMARTRISK, Toronto. [www.smartrisk.ca](http://www.smartrisk.ca).

Angus, Douglas, et al. (1998), *The Economic Burden of Unintentional Injury in Canada*, SMARTRISK, Toronto. [www.smartrisk.ca](http://www.smartrisk.ca).

Biggs, David, and Dan Levy (2000), *Transit’s Safety and Security Record*, Canadian Urban Transit Association [CUTA], Toronto [Strategic Transit Research Program Synthesis S3].

Canadian Paraplegic Association [CPA] (2000), *Spinal Cord Injury in Canada*, CPA, Ottawa. [www.canparaplegic.org](http://www.canparaplegic.org).

Chan, Walter H. [Ontario Ministry of the Environment], *Addressing Smog Pollution in Ontario* [speaker’s outline and data slides], presentation at the Transportation, Air Issues and Human Health Conference, sponsored by Pollution Probe, Toronto, April 28-29, 2003. [www.pollutionprobe.org](http://www.pollutionprobe.org).

***Transport 2000 Ontario***  
**Spine and Brain Injuries from Vehicle Crashes: The Human and Economic Cost**

Goetz, Christopher, and Eric Pappert (1999), *Textbook of Clinical Neurology*, Saunders, Philadelphia.

Hamilton Health Sciences Corporation, Chedoke Hospital, Acquired Brain Injury Rehabilitation Services, *Glasgow Outcome Scale*, n.d., Hamilton, Ontario [based on, Jennette, B., and M. Bond 1975, "Assessment of Outcome After Severe Brain Damage" *Lancet* I:480].

Health Canada (1997), *Economic Burden of Illness in Canada 1993*, Minister of Public Works and Government Services Canada, Ottawa.

Ontario Ministry of Environment [OMOE] (2000), *Air Quality in Ontario: 2000 Report*, Queen's Printer, Toronto.

Ontario Ministry of Finance (2000), *Public Accounts 1999-2000*, Queen's Printer, Toronto.

Ontario Ministry of Transportation [OMOT] (2001), *Ontario Road Safety Annual Report [ORSAR] 2001*, Toronto. [www.mto.gov.on.ca](http://www.mto.gov.on.ca).

Ontario Medical Association [OMA] (June, 2000), *The Illness Costs of Air Pollution in Ontario: A Summary of Finding*, Toronto. [www.oma.org](http://www.oma.org).

Emergency Medicine and Injury Research Group (January, 2003) [EMIRG], *Traumatic Head and Spinal Injuries in Ontario, Canada* [poster], Queen's University, Queen's University.

Stoler, Diane Roberts, and Barbara Albers Hill (1998), *Coping With Mild Traumatic Brain Injury*, Avery Publishing Group, New York.

Tator, Charles H., *Pain Following Spinal Cord Injury*, n.d. [chapter from book, source and date unknown].

Transport Canada (2002), *Transportation in Canada 2002 Annual Report*, Transport Canada, Ottawa. [www.tc.gc.ca/pol/en/Report/anre2002/tc2002ae.pdf](http://www.tc.gc.ca/pol/en/Report/anre2002/tc2002ae.pdf) (also the appendix of this report at [.../tc2002app-e.pdf](http://.../tc2002app-e.pdf)).

U.S. National Spinal Cord Injury Database [NSCID] (May, 2001), *Spinal Cord Injury Facts and Figures at a Glance*. [www.spinalcord.uab.edu](http://www.spinalcord.uab.edu).

Vodden, Keith, et al. (1994), *The Social Cost of Motor Vehicle Crashes in Ontario*, Ontario Ministry of Transportation, Toronto.

***Transport 2000 Ontario***  
**Spine and Brain Injuries from Vehicle Crashes: The Human and Economic Cost**

**ADDENDUM**

*Transit's Safety Record in Canada.* The Canadian Urban Transit Association (CUTA) has published a report on the safety and security record of public transit in Canada (Biggs and Levy, 2000). The report examines safety across a variety of travel modes including transit, school bus, automobile (urban and non-urban), inter-city bus, inter-city rail, air, passenger ferry, and bicycle. We report here briefly some of the safety data for passenger travel by transit, auto, inter-city bus and rail, and air.

The measure of safety used in the CUTA study is the number of fatalities and injuries per billion of passenger kilometres travelled. The rates presented are for the most recent ten-year period (usually 1988-1997 or 1989-1998), except for air (16 years) and inter-city bus (13 years). The data focus on passengers and not on the occupants of other vehicles involved in a collision. The data exclude paid operators and staff. The high level of passenger safety for virtually all modes of public transport is evident in the data summarized from the CUTA study in the table below.

Mode of transportation	Fatality rate per billion passenger-kilometres	Injury rate per billion passenger-kilometres
Transit: on-board fatality	0.045	
Transit: entry/exit/station (Note a)	0.112	
Transit: total (Note b)	0.157	300
Motor vehicle: urban	3.2	390
Motor vehicle: non-urban	10.8	270
Inter-city bus: on-board	1.56	120 (Note c)
Inter-city rail: on-board	0.37	
Air: major carriers (Level 1A) (Note d)	less than 0.026	
Air: major charter (Levels 1B-2)	0.06 – 1.8	
Air: regional carriers (Levels 1B-2) (Note e)	0.5	
Air: commuter/air taxi (Level 3)	3	

Note a: Excludes walking to and from station/bus stop.

Note b: Includes injuries sustained in collisions, while boarding or exiting the vehicle or while inside the vehicle or station or bus stop; based on data for 1993-1995.

Note c: Includes injuries to passengers on-board and entering and exiting the bus, and pedestrians.

Note d: For Level 1A the period is 1983-98; for all other levels, the period is 1989-98.

Note e: Includes Level 1 carriers Air BC and Time Air in 1991-1993.

Data in table synthesized from Briggs and Levy (2000), pp. 7-13.