

THE
ECONOMIC
BURDEN OF
UNINTENTIONAL
INJURY
IN SASKATCHEWAN

presented by

SMART RISK™



SAUVE-QUI-PENSE^{MC}

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in partnership with

Acquired Brain Injury
 Partnership Project



Saskatchewan
 Health

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Saskatchewan
 Institute on
 Prevention of
 Handicaps

The Economic Burden of Unintentional Injury in Saskatchewan
 Submitted to SMARTRISK
 ISBN: 1-894828-16-X
 2001

Study conducted by Terry Albert and Eden Cloutier
 based on the study "The Economic Burden of Unintentional Injury in Canada" by The Hygeia Group.

Additional support for "The Economic Burden of Unintentional Injury in Canada" from  Health Canada Santé Canada

Cover photograph courtesy of Western Red Lily Project

INTRODUCTION

Injury has recently been identified as a major public health problem in Canada and a significant threat to the economy, health care system and overall quality of life. Although the greatest cost of injury is in human suffering and loss, the financial costs are far from trivial. A landmark study unveiled the staggering costs of unintentional injury in Canada amounting some \$8.7 billion (SMARTRISK, 1998)¹. Nationally, injury ranks third behind cardiovascular and musculoskeletal disease in terms of societal economic burden (Health Canada, 1997). Yet, it ranks last in terms of the research share of the total costs and it persists as a predominantly hidden epidemic.

There are two categories of injury: unintentional and intentional (murder, acts of violence and suicide). Unintentional injuries, which are very responsive to prevention, include falls, motor vehicle crashes, railway and pedestrian injuries, drowning and suffocation, poisoning and fires.

Other countries have recognized injuries as a major threat to human health and well-being and they have devised action-oriented responses. The United States now have a National Centre for Injury Prevention and Control (Sleet et al., 1998) and the British government has recently identified injury as one of four health priorities along with heart and stroke, cancer, and mental health (Department of Health, 1998).

THE SASKATCHEWAN CONTEXT

The government of Saskatchewan has demonstrated that it believes in proactive responses to preventable health problems. The people of Saskatchewan understand that injuries kill and disable people every day. They also understand that injuries cost money. But do the people of Saskatchewan know how much money is spent on injuries? The Acquired Brain Injury Partnership Project decided to conduct a study on The Economic Burden of Unintentional Injury in Saskatchewan to determine the health care costs and other societal costs associated with unintentional injuries.

This study on The Economic Burden of Unintentional Injury in Saskatchewan demonstrates that the public health threat of unintentional injury is more pronounced in Saskatchewan, whereby Saskatchewan's injury hospitalization rate and death rate are higher than the national average.

This report goes beyond the economic consequences of this public health threat to proposing solutions to reducing human pain, suffering and grief through enhancing the province's existing investments, policies and programs in injury prevention and control. The ultimate goal is to build upon Saskatchewan's strong tradition in injury prevention towards a truly integrated and coordinated injury prevention and control strategy both within the province and nationally.

TABLE 1 - SUMMARY OF FINDINGS, SASKATCHEWAN, 1998

Injury Deaths	Hospitalized Injuries	Non-Hospitalized Injuries	Total Injuries	Injuries Resulting in Partial Permanent Disability	Injuries Resulting in Total Permanent Disability	TOTAL ANNUAL COST
329	9,848	148,361	158,538	3,317	259	\$595 Million

¹ The Economic Burden of Unintentional Injury in Saskatchewan is based on a more comprehensive review of the literature which is available from the SMARTRISK website: www.smartrisk.ca/library.html

It is expected that the results of this study will provide the necessary economic rationale and impetus for policy makers, providers, managers and citizens to make recommendations needed to bring injury prevention to the forefront of health sector policy discussions, as well as to improve existing treatment and rehabilitation approaches. These discussions would encompass behavioural changes, programming initiatives, communication strategies, engineering strategies, legislative, regulatory and enforcement initiatives, community outreach programs, injury and age specific education initiatives and an extension of injury prevention networks and coalitions that would be necessary to bring about significant reductions in unintentional injuries. In addition, recommendations for improving the measurement and reporting of injury information could be important by-products of this study.

APPROACH TO THE STUDY ²

Economic burden of illness or cost of illness (COI) studies are used to characterize the economic dimensions of various health problems/conditions as a key input for planning, budgeting and priority setting. Often, the burden of specific illnesses is compared to the gains or return on investment available from prevention and control programs.

COI studies generally follow two approaches - incidence costing or prevalence costing. The latter captures all costs incurred in a given year. The major limitation with this approach is that the full episode of illness, which may span multiple years or a full lifespan, is not captured. The incidence costing method assigns all costs (present and the future stream) to year of injury occurrence. Otherwise, for all injuries occurring in a given year, the present and future costs associated with the full episode are captured. The stream of future costs is

discounted to a present value. Hence, with this approach, the cost of an injury occurrence (i.e. full episode) can be compared to the cost associated with the prevention of that injury. Prevention costs are actually investments. For example, 1 dollar spent on bicycle helmets averts 29 dollars in injury costs (CDC, 2000).

Cost-of-illness studies distinguish and measure both direct costs and indirect costs.

Direct costs could be generally considered health care costs. These costs would include goods such as medications, prostheses, and services such as health care provider consultations involved in treatment and rehabilitation.

Indirect costs are societal productivity losses which account for the individual's inability to perform his or her major activities which result from the injuries. Indirect costs are generally captured through measuring foregone/lost income. As well as these economic costs there are certain intangible costs associated with injuries such as pain and suffering, economic dependence and social isolation. While these costs are difficult to quantify in economic terms, they are costs nonetheless and should at least be recognized. This study did not attempt to quantify these costs and, hence, the indirect costs uncovered can be considered conservative.

Estimation of Non-Hospitalized Injuries

The vast majority of injury data in Canada relate to inpatient hospital stays. Given that there was not a comprehensive data set available to provide national incidence estimates for non-hospitalized injury, it was necessary to search the literature for alternative data sources. As noted in Appendix D, the Miller et al. (1995) study is one such source which found, based on a ratio of non-hospitalized unintentional injury

² For a more detailed description of the methodology and construction of the ERAT see Appendix C

cases to hospitalized cases, the incidence for non-hospitalized unintentional injury for Canada in 1995-96 was calculated.

This significant data book also provided the data necessary to calculate the ratio of the costs of non-hospitalized unintentional injury to the costs of hospitalized unintentional injury. This ratio was used to estimate the direct costs of non-hospitalized unintentional injury in Canada.

These variables were used to construct an Electronic Resource Allocation Tool (ERAT) for Saskatchewan which embodies a classification and costing framework designed around existing provincial injury data and data available from the injury costing literature. In essence, the ERAT combines existing data with variables from the literature in order to model full episodic costs for various injuries ranging from falls to motor vehicle crashes to drownings. The ERAT is a flexible tool that can be updated as more/better data become available and according to changes in population, injury incidence and treatment patterns/costs.

RESULTS³

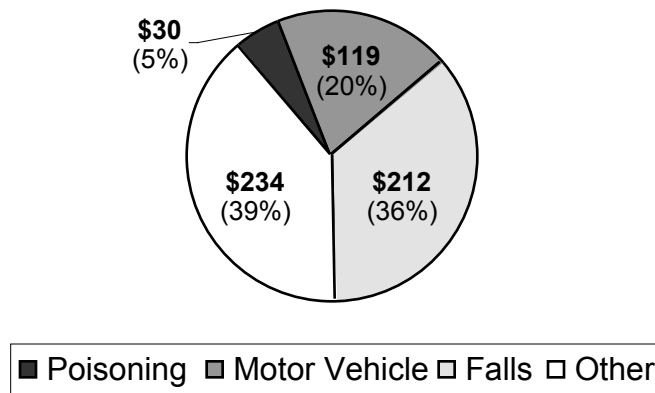
The results highlight a crucial issue. If these injuries are largely preventable, then how much more money and how many more lives could Saskatchewan save by enhancing existing strategic prevention programs? To demonstrate, the study offers examples of prevention strategies showing the extent to which Saskatchewan could save money and lives.

Total Costs

In 1998 preventable injuries cost the people of Saskatchewan \$595 million or \$576 for every citizen. Falls accounted for \$212 million or 36 per cent of the total amount. Motor vehicle crashes cost \$119 million or roughly 20 per cent of the \$595 million. The remaining 44 per cent of total costs can be attributed to a combination of costs incurred by drowning, poisoning, fires, railway, motor vehicle non-traffic, pedal cycle, water transport, air and space, natural and environmental, recreational and other incidents (see fig. 1). On average, each injury generates \$3,700 in direct and indirect costs.

FIGURE 1

Total Costs by Injury Type (Millions \$)
(total costs = \$595)



³ Tables detailing the results of the study are appended

Direct Costs

Over 158,000 injuries in 1998 accounted for almost \$255 million in direct health care costs (see fig. 2). The most costly injuries were falls, totaling almost \$125 million or 49 per cent of total direct costs, and motor vehicle crashes at \$32 million or 12 per cent of direct costs (see fig. 3). The people of Saskatchewan spent \$10 million treating patients for poisoning.

These three types of injury - falls, motor vehicle crashes and poisoning - made up over 65 per cent of direct costs. Caring for the injured elderly amounted to \$69 million or 27 per cent of the \$255 million in direct costs. Roughly \$56 million (82 per cent) of the direct cost of elder injuries is attributable to falls (see fig. 4) where 70 per cent of the costs (approximately \$39 million) are generated by falls among elderly women (see fig. 5). Treating children and youth for falls cost close to \$31 million or 25 per cent

FIGURE 2

Total Costs of Unintentional Injuries (Millions \$)
(total costs = \$595)

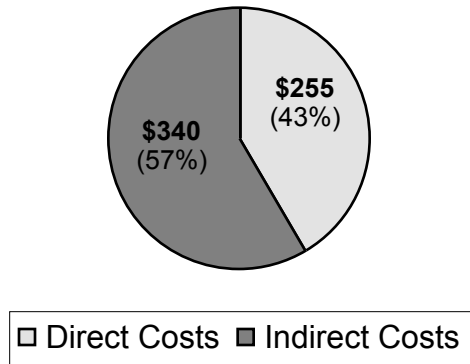


FIGURE 3

Direct Costs by Injury Type (Millions \$)
(total direct costs = \$255)

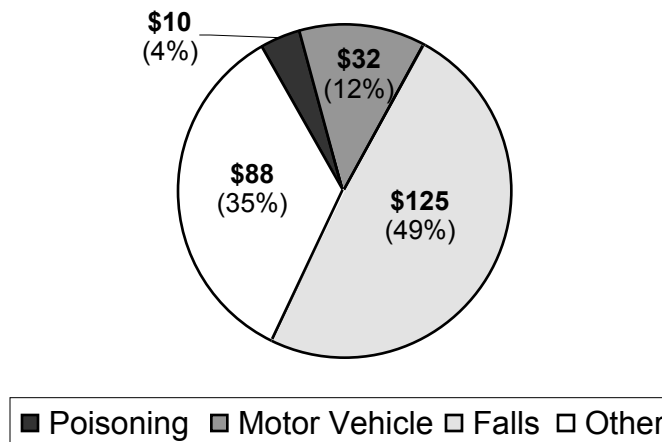


FIGURE 4

Costs for Treating the Injured Elderly (Millions \$)

(total costs for treating the injured elderly = \$69)

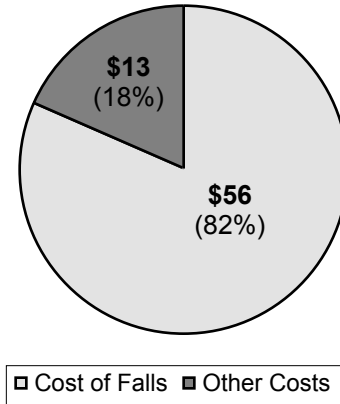
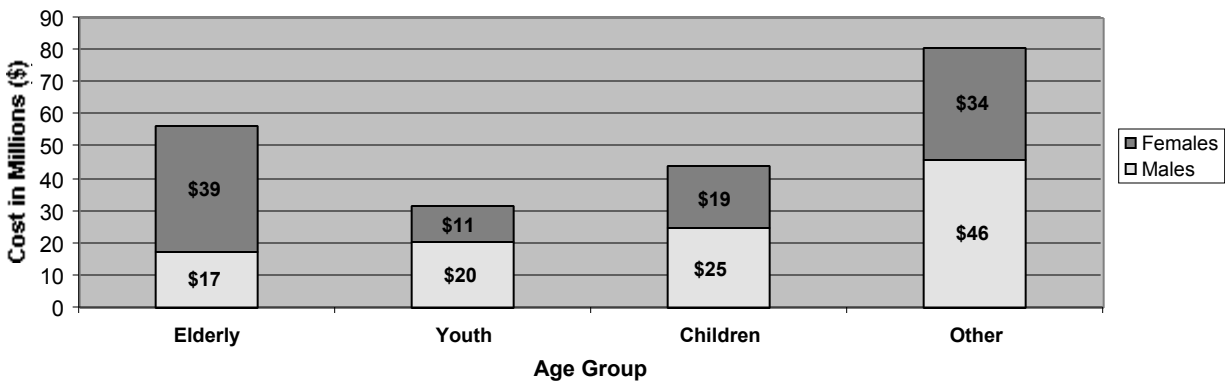


FIGURE 5

Total Costs of Falls by Gender and Age Group (Millions \$)

(total costs of falls = \$212)



of the total fall amount, with males representing 23 per cent more cases than females (See fig. 6 and 9).

Although only 6 per cent of patients injured ended up in hospital, the cost of hospitalization generated 12.5 per cent or nearly \$33 million of the \$255 million spent on direct costs. However, 94 per cent of the injuries assessed were not hospitalized, accounting for 87.5 per cent or an estimated \$222 million of the total direct costs.

Indirect Costs

The 3,905 injuries that led to permanent disability or death amount to \$340 million in indirect costs (see fig. 2). Permanent disability caused the greatest losses in productivity, amounting to over \$252 million or 74 per cent of indirect costs. Injuries causing death accounted for almost \$86 million of the \$340 million total (See fig. 7). The two most significant types of injury causing permanent disability were falls and motor vehicle crashes generating over \$122 million in indirect costs. Falls accounted for \$85 million (34 per cent). Motor vehicle

FIGURE 6

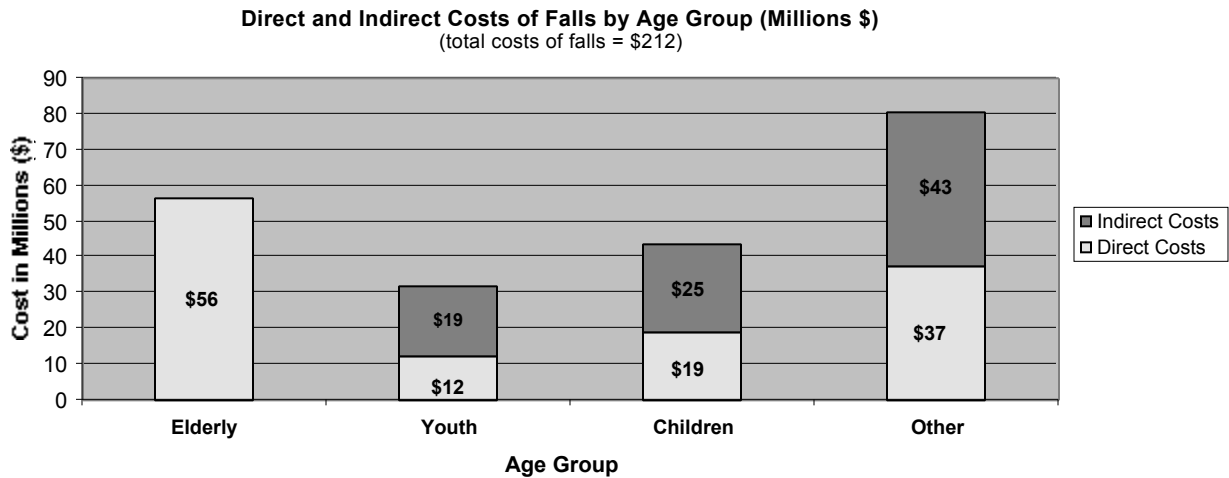
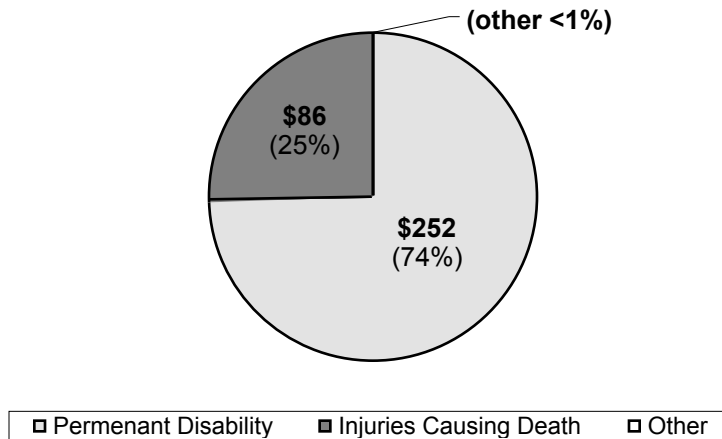


FIGURE 7

Sources of Indirect Costs (Millions \$)
(total indirect costs = \$340)



crashes cost \$37 million (15 per cent) of the total disability-related indirect costs (See fig. 8).

THE COST OF A SILENT EPIDEMIC

The staggering costs determined by this study prove that Saskatchewan is suffering from an injury epidemic that is more pronounced than the situation in other provinces and overall in Canada. Compared to national figures, the injury hospitalization rate is over two times higher in

Saskatchewan and the death rate from injury is 1.4 times higher. But it is a silent epidemic because, generally, people do not see the risk in their everyday lives. If they do not see the risk, they cannot take measures to navigate that risk in order to prevent potential injury. Why can't we see the risk in our lives?

The problem stems from a universal misunderstanding and misuse of the word 'accident.' Injuries sustained by falls or motor vehicle crashes are not seen as the

result of predictable events but rather to be the result of 'accidents' or 'acts of fate'. Yet when someone suffers from heart disease or cancer, high cholesterol and smoking are identified as possible predictable causes.

Health policy must first acknowledge that injuries are predictable and preventable. Injuries are not accidents, and investing in injury prevention can save money and lives. The people of Saskatchewan do not need to

FIGURE 8

Indirect Disability Costs by Injury Type (Millions \$)

(total indirect disability costs = \$252)

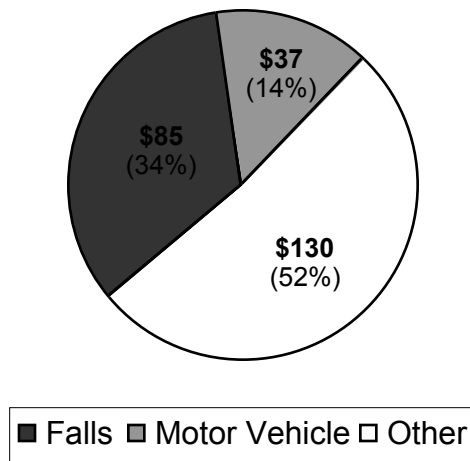
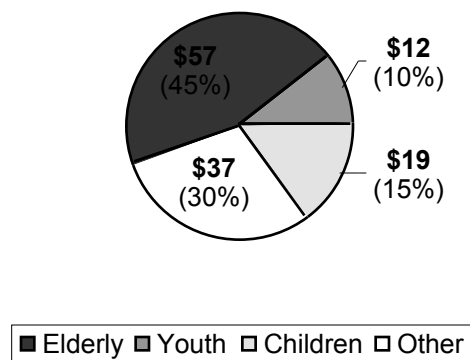


FIGURE 9

Direct Costs of Falls by Age Group (Millions \$)

(direct costs of falls = \$125)



spend over half a billion dollars each year on nearly 180,000 injuries that could largely have been prevented in the first place.

INJURY PREVENTION CUTS COSTS

There is a stark contrast between the cost of preventing injuries and the cost of treating injuries. Prevention always costs less⁴:

- \$1 spent on smoke alarms saves \$69
- \$1 spent on bicycle helmets saves \$29
- \$1 spent on child safety seats saves \$32
- \$1 spent on road safety improvements saves \$3
- \$1 spent on prevention counseling by pediatricians saves \$10
- \$1 spent on poison control services saves \$7

Saskatchewan Health has invested in programs and in strategies to tackle the injury problem. How much money could enhancement of current injury prevention programs save the people of Saskatchewan? The following scenarios illustrate how targeting the most costly causes of injury combined with the most vulnerable

population groups can generate real savings. Combined, these conservative injury reduction targets could produce \$54 million in savings annually. More savings could be available through the development of an injury prevention and control strategy.

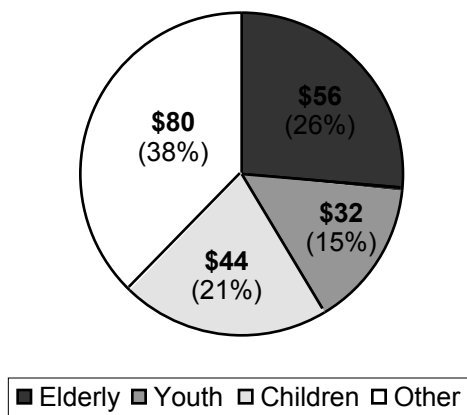
Falls among the elderly

This study has shown that over \$57 million of the \$125 million in direct costs spent on falls was devoted to treating falls among the elderly (see fig. 9). It is estimated that about 40 per cent of falls leading to hospitalization are the result of hip fractures, and that the number of hip fractures in Canada will increase dramatically from 23,375 in 1993 to over 88,000 cases by the year 2041 as the Canadian population ages.⁵

These are falls that can be prevented by recognizing risk factors such as a history of falls, impairment related to cognition, balance and gait, low body mass index, the misuse of medications and hazards in the home. By targeting these risk factors through prevention programs, setting a hospitalization reduction target of 20 per cent could lead to almost 600 fewer hospital stays and 145

FIGURE 10

Total Costs of Falls by Age Group (Millions \$)
(total costs of falls = \$212)



⁴ Centers for Disease Control and Prevention (2000). Working to Prevent and Control Injury in the United States - Fact Book for the Year 2000. National Center for Injury Prevention and Control, Atlanta.

⁵ Papadimitropoulos, EA, Coyte, PC, Joss, MB and CE Greenwood, "Current and Projected Rates of Hip Fracture in Canada", Canadian Medical Association Journal, 1997, Vol 157: 1357 - 63.

fewer elderly people of Saskatchewan permanently disabled. The overall savings could amount to almost \$8 million annually.

Childhood falls

Injuries from childhood falls cost the people of Saskatchewan \$44 million every year (see fig. 10). These are falls that can be prevented by redesigning the structure of playgrounds, targeting hazards in the home and by simply teaching children how to fall.

If these types of prevention strategies reduce the incidence of falls by 20 per cent for children aged 0-9, there would be over 100 fewer hospitalized children in Saskatchewan, almost 1,000 fewer non-hospitalized injuries, and 40 fewer injuries leading to permanent disability. The net savings could total \$9 million every year.

Preventing motor vehicle crashes

Wearing seat belts and installing air bags can reduce motor vehicle injuries by 61 per cent. Drinking and driving is responsible for about 40 per cent of all fatal motor vehicle crashes. It is estimated that mortality can be reduced by 20 per cent through a reduction in drunk driving (Rivara, et al, 1997). Reducing speed limits by 10 km an hour could lead to a 15 per cent decrease in mortality, with the number of deaths lowered and severity of injury reduced (Barach & Richter, 1998).

With a 10 per cent reduction in crashes caused by poor road design and maintenance, and based on the assumption that 20 per cent of those injured end up in hospital, there would be about 50 fewer deaths each year. Continuing to support a prevention strategy based on buckling up, driving sober, slowing down and looking first on the roads, would result in almost 350 fewer hospitalizations, about 480 fewer injuries treated outside a hospital setting and almost 80 fewer injuries leading to permanent disability. The net savings to the people of Saskatchewan would amount to \$37 million annually.

PUTTING A PRICE TAG ON PREVENTION

Preventing injuries saves money and lives. The goal of reducing costs and human suffering can be reached by integrating existing government and community-based programs into a provincial injury prevention strategy. A recent study estimated that diabetes costs the Canadian economy \$1.1 billion annually. In response, governments and non-governmental organizations devised and funded a five year, \$115 million Canadian Diabetes Strategy. This adds to the list of several national strategies for various health conditions. A key question emerges: are the economic costs of unintentional injury comparable to other priority areas?

For example, the annual estimated direct costs for treating diabetes and diabetes related illnesses in Saskatchewan is \$147 million (Report of the Saskatchewan Advisory Committee on Diabetes, 2000). In contrast, the annual direct costs for treating unintentional injuries in Saskatchewan is \$255 million (see figure 2).

Nationally, the annual societal costs for unintentional injury amount to almost \$9 billion. In comparison to other health conditions, unintentional injury would rank in the top five in terms of societal economic burden. In Britain, unintentional injury was established as one of the top five national health priorities. The issue is not investing in one health problem at the expense of another. Rather, the key issue is the funding and formulation of a strategy. We know that strategies are essential to the control of many health problems.

The findings of this study point to the pay-offs that Saskatchewan could reap through investing in a provincial injury prevention strategy. Importantly, a provincial strategy could be substantially enhanced through integration with a national strategy. At this time, Canada does not have a national strategy for injury prevention and control.

THE POLICY CONTEXT

Progress towards developing a national injury prevention strategy has been made in the past. But it has not moved forward. For example, strategists working in 1991 on a project entitled *A Safer Canada: Year 2000 Injury Control Objectives* developed a series of prevention objectives. They recommended that the Government of Canada recognize injuries as a major cause of death and disability that requires a national prevention strategy. They encouraged the development of national injury control objectives for the purpose of stimulating projects across the country. They also called for the establishment of a national injury surveillance system.

None of the recommendations has been fully realized. Saskatchewan can again become a leader. The results of *The Economic Burden of Unintentional Injury in Saskatchewan* demonstrate that a provincial injury prevention strategy is not only essential, it is integral to the fight against this silent epidemic.

While it goes without saying that the primary goal is to reduce human pain and suffering, the societal implications also have to be made clear. Unintentional injury is the number one killer of young Canadians. As our population ages and as we move towards a new economy, Saskatchewan's and Canada's future is dependent on this shrinking body of human capital. We can ill afford the current losses in face of the demographic and economic changes that lie ahead.

RECOMMENDING A PROVINCIAL INJURY PREVENTION STRATEGY

It is time for the people of Saskatchewan to see the risk, reduce the risk, and ultimately manage the risk in their lives. Preventable injuries harm and end the lives of many people in Saskatchewan and exact a heavy toll on the province's limited health and financial resources. A Provincial Injury

Prevention Strategy in concert with a coordinated National Injury Prevention Strategy would be ideal.

This strategy must be guided by strong leadership and supported by varied collaborative efforts across injury prevention groups. Collaboration will guarantee the establishment of priorities and will ensure diverse and innovative approaches to prevention. Injury prevention strategies usually incorporate three main components:

1. Comprehensive Programming

- Innovative communication strategies designed to show the people of Saskatchewan the risks in their everyday lives, and ultimately enabling them to take smart risks.
- Community mobilization and outreach programs that will distribute the message and reduce the risks.
- Engineering strategies designed to reduce the likelihood of injury.
- The development of age-specific educational initiatives.
- An extension of injury prevention networks and coalitions.
- The design and implementation of programming initiatives that will put injury prevention at the top of the province's public policy agenda.
- Legislative and regulatory initiatives at all government levels.

2. Provincial Injury Surveillance System

Data is the lifeline of any Injury Prevention Strategy. Surveillance is akin to "switching on the lights". Saskatchewan currently has some of the components necessary to support the implementation of a comprehensive provincial injury surveillance system that would ideally be connected to a national system. In order to prevent an injury, members of a provincial strategy coalition must know who is getting injured. They also need to know how they are getting injured and what happens to them after they are hurt. They must know the age, sex, and the socio-economic status of the injured person. These

variables will influence specific injury prevention strategies targeting high-risk population groups as well as the most common and costly causes of injury.

3. Research

Finally, this study points to the urgent need for further research into all aspects of preventing injuries including the epidemiology of preventable injury as well as ongoing evaluation of prevention initiatives. Cost-benefit projections for proposed cost-cutting prevention strategies need to be developed as well as cost-benefit evaluation for programs already in place.

The Provincial Injury Prevention Strategy will provide leadership harnessed by strong collaboration, supported by excellent data and surveillance systems, and kept alive by sophisticated research and evaluation programs. By investing in an Injury

Prevention Strategy, Saskatchewan will no longer be able to call the injury epidemic 'silent'. People will begin to see the risks in their lives. They will begin to understand how to take smart risks, ultimately saving both money and lives.

Conclusion

Every hour of every day, 18 people in Saskatchewan are unintentionally injured (434 per day), roughly one person in Saskatchewan dies daily from these injuries and over 3,500 are disabled every year. Overall, almost 160,000 residents of Saskatchewan are injured each year.

The rationale is clear. The government of Saskatchewan views this both as an opportunity and challenge in enhancing the core existing injury prevention programs and policies to ultimately improve the quality of life of the people of Saskatchewan.

APPENDICES

APPENDIX A

Bibliography

- Acton, JP (1073), Evaluating Public Programs to Save Lives: The Case of Heart Attacks, Rand Cooperation, Santa Monica.
- Agran, PF, DG Winn and CLAnderson (1995), "Surveillance of pediatric injury hospitalization in Southern California", *Injury Prevention*, Vol. 1, No. 4: 234-237.
- Albert, Terry and Gregory Williams (1998), *The Economic Burden of HIV/AIDS in Canada*, Canadian Policy Research Networks, Inc., Ottawa.
- Angus, Douglas E., Ludwig Auer, J. Eden Cloutier and Terry Albert (1995), *Sustainable Health Care for Canada*, Queen's-University of Ottawa Economic Projects, Ottawa.
- Baker, LC and AB Krueger (1995), "Medical costs in workers' compensation insurance", *Journal of Health Economics*, Vol. 14: 531-549.
- Barach, P and E Richter (1998), "Injury Prevention" (Editorial), *New England Journal of Medicine*, Vol. 338, No. 2: 132.
- Barss, Peter, et al (1998). Quoted in *Injury Prevention: An International Perspective*. Oxford University Press, New York.
- Bass, JL, KK Christoffel, M Widome, W Boyle, P Scheidt, R Stanwick and K Roberts (1993), "Childhood Injury Prevention Counseling in Primary Care Settings: A Critical Review of the Literature", *Pediatrics*, Vol. 92, No. 4: 544-550.
- Berry, RE and JP Boland (1977), *The Economic Cost of Alcohol Abuse*, Free Press, New York.
- Bolhofner, B, BA Carmen, SD Devereux and K Harlen (1994), "Motorcycle Accident Injury Severity, Blood Alcohol Levels, Insurance Status, and Hospital Costs: A 4-Year Study in St.Petersburg, Florida", *Journal of Orthopaedic Trauma*, Vol. 8, No. 3: 228-232.
- Bruce, CJ (1979), "The Calculation of Foregone Lifetime Earnings: Three Decisions of the Supreme Court of Canada", *Canadian Public Policy*, Vol. 5, No. 2: 155-167.
- Canada Pension Plan (1995), *Projections Underlying the 15th Actuarial Report*, Office of the Superintendent of Financial Institutions, Ottawa.
- Cassidy, M and A Klymasz (1995), *Economic Costs of Schizophrenia in Canada*, Prepared for The Schizophrenia Society of Canada and Health Canada.
- CDC (2000). Centers for Disease Control and Prevention. *Working to Prevent and Control Injury in the United States - Fact Book for the Year 2000*. National Center for Injury Prevention and Control, Atlanta.
- Children's Safety Network (1996), *Childhood Injury: Cost & Prevention Facts*, CSN Economics and Insurance Resource Center, Washington, DC.
- Conley, R and A Milunsky (1975), "The economics of prenatal genetic diagnosis", in A Milunsky (Ed.), *The Prevention of Genetic Disease and Mental Retardation*, WB Saunders, Philadelphia.
- Cooper, BS and DP Rice (1976), "The economic cost of illness revisited", *Social Security Bulletin*, Vol. 39, No. 2 (February): 21-36.
- Declich, S and AO Carter (1994), "Public health surveillance: historical origins, methods and evaluation", *Bulletin of the World Health Organization*, Vol. 72, No. 2: 285-304.

- Elvik, R (1994), "The External Costs of Traffic Injury: Definition, Estimation, and Possibilities for Internalization", *Accident Analysis and Prevention*, Vol. 26, No. 6: 719-732.
- Elvik, R (1995), "An Analysis of Official Economic Valuations of Traffic Accident Fatalities in 20 Motorized Countries", *Accident Analysis and Prevention*, Vol. 27, No. 2: 237-247.
- Englander, F, TJ Hodson and RA Terregrossa (1996), "Economic Dimensions of Slip and Fall Injuries", *Journal of Forensic Sciences*, Vol. 41, No. 5: 733-746.
- Evans, AW (1994), "Evaluating Public Transport and Road Safety Measures", *Accident Analysis and Prevention*, Vol. 26, No. 4: 411-428.
- Fraser, RD, RA Spasoff and MG Prime (1976), *Toward the establishment of health research priorities: An estimate of the economic burden of ill health*, Ontario Economic Council, Toronto.
- Fuortes, LJ, Y Shi, M Zhang, C Zwerling and M Schootman (1994), "Epidemiology of Back Injury in University Hospital Nurses from Review of Workers' Compensation Records and a Case-Control Survey", *Journal of Occupational Medicine*, Vol. 36, No. 9: 1022-1026.
- Ginsberg, GM and DS Silverberg (1994), "A Cost-Benefit Analysis of Legislation for Bicycle Safety Helmets in Israel", *American Journal of Public Health*, Vol. 84, No. 4: 653-656.
- Gustafson, DH (1995), "The Total Costs of Illness: A Metric for Health Care Reform", *Health Services Administration*, Vol. 40, No. 1: 154-171.
- Hansen, P and PA Schuffham (1995), "The cost-effectiveness of compulsory bicycle helmets in New Zealand", *Australian Journal of Public Health*, Vol. 19, No. 5: 450-454.
- Hartunian, NS, CN Smart and MS Thompson (1980), "The Incidence and Economic Costs of Cancer, Motor Vehicle Injuries, Coronary Heart Disease, and Stroke: A Comparative Analysis", *American Journal of Public Health*, Vol. 70, No. 12: 1249-1260.
- Hatziandreu, EJ, JJ Sacks, R Brown, WR Taylor, ML Rosenberg and JD Graham (1995), "The Cost Effectiveness of Three Programs to Increase Use of Bicycle Helmets Among Children", *Public Health Reports*, Vol. 110, No. 3: 251-259.
- Health Canada (1991), "Economic Burden of Illness in Canada 1986", Supplement to Vol. 12, No. 3.
- Health Canada (1996), *National Health Expenditures in Canada, 1975-1994*, Supply and Services Canada, Ottawa.
- Health Canada (1997), *Economic Burden of Illness in Canada 1993*, Minister of Public Works and Government Services Canada, Ottawa.
- Hendrie, D, DL Rosman and AH Harris (1994), "Hospital inpatient costs resulting from road crashes in Western Australia", *Australian Journal of Public Health*, Vol. 18: 380-388.
- Hoyos, CG and B Zimolong (1988), "Occupational safety and accident prevention", *Advances in Human Factors/Ergonomics*, Vol. 11: 167-178.
- Injury Awareness and Prevention Centre (1991), *A Safer Canada: Year 2000 Injury Control Objectives for Canada*, University of Alberta.
- Jefferson Rowland, MS, F Rivara, P Salzberg, R Soderberg, R Maier and T Koepsell (1996), "Motorcycle Helmet Use and Injury Outcome and Hospitalization Costs from Crashes in Washington State", *American Journal of Public Health*, Vol. 86, No. 1: 41-45.
- Jones-Lee, MW (1989), *The economics of safety and risk*, Basil Blackwell, Oxford.

- Kopjar, B and TM Wickizer (1996 a), "Population-based Study of Unintentional Injuries in the Home", *American Journal of Epidemiology*, Vol. 144, No. 5: 456-462.
- Kopjar, B and TM Wickizer (1996 b), "Home Injuries among Adults in Stavanger, Norway", *American Journal of Public Health*, Vol. 86, No. 3: 400-404.
- Krupp, R, K McMahon, R Kulmala, H Duval, U Persson, N Soguel, R Rossel, R Elvik, S Fogh, P Smit, J Mira, A Figueiredo Da Silva, G Gurtlich and J LAlfaro (1993), Socio-economic cost of road accidents, Final Report to Commission of the European Communities, Bruxelles.
- Leamon, TB and PL Murphy (1995), "Occupational slips and falls: more than a trivial problem", *Ergonomics*, Vol. 38, No. 3: 487-498.
- Leger, D (1994), "The Cost of Sleep-Related Accidents: A Report for the National Commission on Sleep Disorders Research", *Sleep*, Vol. 17, No. 1: 84-93.
- Lindqvist, KS and H Brodin (1996), "One-Year Economic Consequences of Accidents in a Swedish Municipality", *Accident Analysis and Prevention*, Vol. 28, No. 2: 209-219.
- Luce, BR and SO Schweitzer (1978), "Smoking and alcohol abuse: a comparison of their economic consequences", *New England Journal of Medicine*, Vol. 238: 569-571.
- Lutton, CE (1994), "Economic Impact of Injuries Associated with Electrical Events", *Annals of the New York Academy of Sciences*, Vol. 720: 272-276.
- Miller, TR and J Guria (1991), The value of statistical life in New Zealand. Market research on road safety, New Zealand Ministry of Transport, Land Transport Division, Wellington.
- Miller, TR, J Viner, S Rossman, N Pindus, W Gellert, J Douglass, A Dillingham and G Blomqvist (1991), The costs of highway crashes, US Department of Transportation, Federal Highway Administration, Washington, DC.
- Miller, TR (1993), "Costs and functional consequences of U.S. roadway crashes", *Accident Analysis and Prevention*, Vol. 25: 593-607.
- Miller, TR, MA Cohen and S Rossman (1993), "Victim costs of violent crime and resulting injuries", *Health Affairs*, Winter: 186-197.
- Miller, TR and LJ Blincoe (1994), "Incidence and Cost of Alcohol-Involved Crashes in the United States", *Accident Analysis and Prevention*, Vol. 26, No. 4: 583-591.
- Miller, TR and M Galbraith (1995 a), "Injury Prevention Counseling by Pediatricians: A Benefit-Cost Comparison", *Pediatrics*, Vol. 96, No. 1: 1-4.
- Miller, TR and M Galbraith (1995 b), "Estimating the Costs of Occupational Injury in the United States", *Accident Analysis and Prevention*, Vol. 27, No. 6: 741-747.
- Miller, TR, MA Cohen and B Wiersema (1995), "Crime in the United States: victim costs and consequences", National Institute of Justice, Washington, DC.
- Miller, TR, NM Pindus, JB Douglass and SB Rossman (1995), *Databook on Nonfatal Injury: Incidence, Costs and Consequences*, The Urban Institute Press, Washington, DC.
- Mills, E and M Thompson (1978), "The economic costs of stroke in Massachusetts", *New England Journal of Medicine*, Vol. 299: 415-418.
- National Center for Health Statistics (1981), *Social and Economic Implications of Cancer in the United States*, US Department of Health and Human Services, Hyattsville.

- Ontario Ministry of Health (1997), *Mandatory Health Programs and Services Guidelines*, Ontario Ministry of Health, Public Health Branch, Toronto.
- Osberg, JS, P Kahn, K Rowe and MM Brooke (1996), "Pediatric Trauma: Impact on Work and Family Finances", *Pediatrics*, Vol. 98, No. 5: 890-897.
- Papadimitropoulos, EA, Coyte, PC, Josse, MB and CE Greenwood, "Current and projected rates of hip fracture in Canada", *Canadian Medical Association Journal*, 1997, Vol 157: 1357-63.
- Persson, U and M Cedervall (1991), The value of risk reduction: Results of a Swedish sample survey, *IHE Working Paper 1991: 6*, The Swedish Institute for Health Economics, Lund.
- Pless, IB (1996), "Childhood injury prevention: time for tougher measures" (Editorial), *Canadian Medical Association Journal*, Vol. 155, No. 10: 1429-1431.
- Postl, BD (1993), "Injuries and Public Health in Canada" (Editorial), *Canadian Journal of Public Health*, Vol. 84, No. 3: 150-1.
- Proctor, TD and V Coleman (1988), "Slipping, tripping and falling accidents in Great Britain - present and future", *Journal of Occupational Accidents*, Vol. 9: 269-285.
- Quebec, Government of (1990), *Economic Costs of Injuries and Fatalities Resulting from the Practice of Sports and Recreational Activities in Quebec*, Régie de la sécurité dans les sports du Québec, Québec.
- Raina, P, V Torrance and J Lindsay (1997), *A Review of the Literature and an Analysis of Mortality and Hospitalization Data to Examine Patterns of Injuries Among Canadian Seniors*, IESOP Research Paper No. 12, McMaster University.
- Rice, DP (1966), *Estimating the Cost of Illness*, PHS Economic Series #6, US Printing Office, Washington.
- Rice, DP, EJ MacKenzie and Associates (1989), *Costs of Injury in the United States, A Report to Congress*, Institute for Health & Aging, University of California and Injury Prevention Center, The Johns Hopkins University.
- Rice, DP et al. (1990), *Economic Costs of Alcohol & Drug Abuse & Mental Illness: 1985*, US Alcohol, Drug Abuse and Mental Health Administration.
- Rivara, FP, DC Grossman and P Cummings (1997), "Injury Prevention: Parts 1 and 2", *New England Journal of Medicine*, Vol. 337, No. 8: 543-548 and Vol. 337, No. 9: 613-618.
- Rufener, BL, JV Rachal and AM Cruze (1976), "Management effectiveness measures for NIDA drug abuse treatment programs", in *Cost to Society of Drug Abuse*, Vol. II: 75-1016.
- Scitovsky, AA (1982), "Estimating the Direct Costs of Illness", *Millbank Memorial Fund Quarterly/Health and Society*, Vol. 60, No. 3: 463-491.
- Sicard, C (1990), *Economic Cost of Injuries and Fatalities Resulting from the Practice of Sports and Recreational Activities in Quebec*, Régie de la sécurité dans les sports du Québec, Trois-Rivières.
- Sleet, David, Sandra Bozo and Christine Branche (1998). *An Overview of the National Center for Injury Prevention and Control at the Centers for Disease Control and Prevention*. *Injury Prevention*, 4:308-312.
- SMARTRISK (1998). *The Economic Burden of Unintentional Injury in Canada*. SMARTRISK, Toronto.

- Smart, CN and CR Sanders (1976), *The Costs of Motor Vehicle Related Spinal Cord Injuries*, Insurance Institute for Highway Safety, Washington, DC.
- Spaite, DW, EA Criss, DJ Weist, TD Valenzuela, D Judkins and HW Meislin (1995), "A Prospective Investigation of the Impact of Alcohol on Helmet Use, Injury Severity, Medical Resource Utilization, and Health Care Costs in Bicycle-Related Trauma", *The Journal of Trauma: Injury, Infection, and Critical Care*, Vol. 38, No. 2: 287-290.
- Tengs, TP, ME Adams, JS Pliskin, DG Safran, JE Seigel, MC Weinstein and JD Graham (1995), "Five Hundred Life-Saving Interventions and Their Cost-Effectiveness", *Risk Analysis*, Vol. 15, No. 3: 369-390.
- Thompson, MS and HJ Meyer (1989), *The Costs of AIDS: Alternative Methodological Approaches*, in Conference Proceedings: *Health Services Research Methodology: A Focus on AIDS*, National Center for Health Services Research and Health Care Technology Assessment.
- Tinetti, ME, DI Baker, G McAvay, EB Claus, P Garrett, M Gottschalk, ML Koch, K Trainor and RI Horwitz (1994), "A multifactorial intervention to reduce the risk of falling among elderly people living in the community", *New England Journal of Medicine*, Vol. 331:821-827.
- UK Foreign & Commonwealth Office (1995), *Improving Britain's Health: Targets, Partnerships*, Information, London.
- University of Alberta Hospitals (1995), *Injury Prevention News*, Injury Prevention Centre, Edmonton.
- Waller, J (1985), *Injury Control. A guide to the causes and prevention of trauma*, D.C. Heath and Company, Lexington, Massachusetts / Toronto.
- Webb, WB (1995), "The Cost of Sleep-Related Accidents: A Reanalysis", *Sleep*, Vol. 18, No. 4: 276-280.
- Weisbrod, BA (1971), "Costs and benefits of medical research: A case study of poliomyelitis", *Political Economy*, Vol. 79: 527-544.

APPENDIX B

TABLE 1

**Deaths Resulting from Unintentional Injury,
Distribution by Major Category, Saskatchewan, 1998**

Major Cause of Death	Number	% Distribution
Motor Vehicle Crashes	127	38.6%
Falls	98	29.8%
Poisoning	27	8.2%
Drowning and Suffocation	16	4.9%
Fires	6	1.8%
Water Transport	6	1.8%
Air & Space	5	1.5%
Railway	1	0.3%
Other	43	13.1%
Total	329	100.0%

TABLE 2

**Unintentional Injuries Resulting in Hospitalization,
Distribution by Major Category, Saskatchewan, 1998**

Major Cause	Number	% Distribution
Falls	5,295	53.7%
Motor Vehicle Crashes	1,238	12.6%
Poisoning	495	5.0%
Pedal Cycle	118	1.2%
Fires	79	0.8%
Water Transport	23	0.2%
Drowning and Suffocation	15	0.2%
Air & Space	7	0.1%
Railway	5	0.1%
Other	2,573	26.1%
Total	9,848	100.0%

TABLE 3

**Unintentional Injuries Resulting in Non-Hospitalization,
Distribution by Major Category, Saskatchewan, 1998**

Major Cause	Number	% Distribution
Falls	58,510	39.4%
Motor Vehicle Crashes	6,000	4.0%
Poisoning	6,147	4.1%
Fires	1,747	1.3%
Pedal Cycle	1,363	0.9%
Water Transport	358	0.2%
Drowning and Suffocation	130	0.1%
Air & Space	87	0.1%
Railway	93	0.1%
Other	73,926	49.8%
Total	148,361	100.0%

TABLE 4

**Unintentional Injuries Resulting in Disability,
Distribution by Major Category, Saskatchewan, 1998**

Major Cause	Partial Permanent Disability	Total Permanent Disability
Falls	1,918	142
Motor Vehicle Crashes	270	40
Poisoning	115	4
Pedal Cycle	39	4
Fires	39	2
Water Transport	8	1
Drowning and Suffocation	3	0
Air & Space	2	0
Railway	2	0
Other	921	66
Total	3,317	259

TABLE 5

**Direct Costs (\$Thousands) Resulting from Unintentional Injury,
Distribution by Major Cause of Injury and Type of Expenditure, Saskatchewan, 1998**

Expenditure Category	Motor Vehicle Crashes	Falls	Drowning and Suffocator	Poisoning	Fires	Other	Total
Hospitalized Cases							
Hospital	4,577.3	19,989.8	28.2	881.3	367.2	6,805.1	32,649.1
Medical	3,979.1	15,436.7	24.4	605.2	151.6	5,437.9	25,634.9
Rehabilitation	303.2	1,015.8	5.0	67.3	11.2	428.3	1,830.8
Sub-Total	8,859.6	36,442.4	57.6	1,553.9	530.0	12,671.4	60,114.8
Non-Hospitalized Cases							
Medical	1,447.1	17,783.2	48.9	1,969.4	372.6	16,840.4	38,461.5
Rehabilitation	96.1	1,189.6	5.3	51.8	60.0	1,235.3	2,638.1
Sub-Total	1,543.1	18,972.8	54.2	2,021.2	432.6	18,075.7	41,099.6
Permanent Disability	21,435.4	69,715.5	332.5	6,370.7	1,503.4	54,535.9	153,893.5
Total Direct	31,838.2	125,130.6	444.3	9,945.7	2,466.0	85,283.0	255,107.8

TABLE 6

**Indirect Costs (\$Thousands) Resulting from Unintentional Injury,
Distribution by Major Cause of Injury and Type of Productivity Loss, Saskatchewan, 1998**

Category of Productivity Loss	Motor Vehicle Crashes	Falls	Drowning and Suffocatio	Poisoning	Fires	Other	Total
Morbidity Costs							
Cases While Hospitalized	307.0	407.8	0.4	24.9	17.8	351.4	1,109.5
Partial Permanent Disability	19,350.5	56,727.4	244.9	7,686.0	3,173.8	86,415.6	173,598.2
Total Permanent Disability	17,516.2	28,259.6	496.0	1,610.0	917.1	29,930.9	78,729.8
Sub-Total	37,173.7	85,394.8	741.4	9,320.9	4,108.7	116,697.9	253,437.4
Mortality Costs	49,444.8	1,699.4	6,918.7	10,759.8	1,819.5	15,484.7	86,127.0
Total Costs	86,618.5	87,094.3	7,660.1	20,080.7	5,928.2	132,182.6	339,564.4

TABLE 7

**Total Economic Costs (\$Thousands) Resulting from Unintentional Injury,
Distribution by Major Cause of Injury and Type of Productivity Loss, Saskatchewan, 1998**

Cost Category	Motor Vehicle Crashes	Falls	Drowning and Suffocatio	Poisoning	Fires	Other	Total
Direct Costs							
Hospitalized Cases	8,859.6	36,442.4	57.6	1,553.9	530.0	12,671.4	60,114.8
Non-Hospitalized Cases	1,543.1	18,972.8	54.2	2,021.2	432.6	18,075.7	41,099.6
Disability	21,435.4	69,715.5	332.5	6,370.7	1,503.4	54,535.9	153,893.5
Total Direct	31,838.2	125,130.6	444.3	9,945.7	2,466.0	85,283.0	255,107.8
Indirect Costs							
Morbidity Costs	37,173.7	85,394.8	741.4	9,320.9	4,108.7	116,697.9	253,437.4
Mortality Costs	49,444.8	1,699.4	6,918.7	10,759.8	1,819.5	15,484.7	86,127.0
Total Indirect	86,618.5	87,094.3	7,660.1	20,080.7	5,928.2	132,182.6	339,564.4
Total Costs	118,456.7	212,224.9	8,104.4	30,026.5	8,394.2	217,465.6	594,672.3

TABLE 8

**Summary of Total Economic Costs Resulting from Unintentional Injury,
Distribution by Major Cause of Injury, Saskatchewan, 1998**

Cause of Injury	Total Cost	Direct Cost	Indirect Cost
Falls	212,224,912	125,130,639	87,094,274
Motor Vehicle	118,456,672	31,838,172	86,618,500
Poisoning	30,026,466	9,945,735	20,080,731
Pedal Cycle	8,736,185	3,621,042	5,115,143
Fires	8,394,213	2,466,013	5,928,200
Drowning and Suffocation	8,104,379	444,299	7,660,079
Water Transport	4,077,611	764,013	3,313,597
Air and Space	2,411,745	239,188	2,172,557
Railway	789,596	220,487	569,109
Other	201,450,487	80,438,260	121,012,227
Total	\$594,672,266	\$255,107,849	\$339,564,417

TABLE 9

Percent Distribution of Total Costs, by Major Category, Saskatchewan, 1998

Cause of Injury	Total Cost	% of Total
Falls	212,224,912	35.7%
Motor Vehicle	118,456,672	19.9%
Poisoning	30,026,466	5.0%
Pedal Cycle	8,736,185	1.5%
Fires	8,394,213	1.4%
Drowning and Suffocation	8,104,379	1.4%
Water Transport	4,077,611	0.7%
Air and Space	2,411,745	0.4%
Railway	789,596	0.1%
Other	201,450,487	33.9%
Total	\$594,672,266	100.0%

TABLE 10

**Scenario 1: Population Effects on Economic Costs of
Unintentional Injury, Saskatchewan**

Year	Population	Total Cost \$ Millions	Direct Cost \$ Millions	Indirect Cost \$ Millions
1998	1,031,933	\$594.7	\$255.1	\$339.6
2010	1,138,629	\$648.2	\$292.4	\$355.8
% Increase	10.3%	9.0%	14.6%	4.8%

SENSITIVITY TABLES**Change of Discount Rate**

Discount Rate	Total Cost \$ Millions	Direct Cost \$ Millions	Indirect Cost \$ Millions
3% (Base Case)	\$594.7	\$255.1	\$339.6
5%	\$453.3	\$207.8	\$245.5
% Change	-23.8%	-18.5%	-27.7%

Change of Unemployment Rate

Unemployment Rate	Total Cost \$ Millions	Direct Cost \$ Millions	Indirect Cost \$ Millions
6.08% (Base Case)	\$594.7	\$255.1	\$339.6
5%	\$598.6	\$255.1	\$343.5
% Increase	0.7%	N/A	1.1%

APPENDIX C

The Electronic Resource Allocation Tool

The ERAT (Electronic Resource Allocation Tool) consists of a series of spreadsheets designed to calculate the incidence costs of unintentional injury. The tool was created to fulfill two major objectives:

- to supply modeling and estimation techniques required to fill critical gaps in the available data in Canada
- to serve as a resource tool that can be used by researchers and public health officials at provincial and local levels to support resource allocation, policy development and decision-making.

Modeling and Estimation Techniques

While evaluating The Economic Burden of Unintentional Injury in Canada, the study researchers discovered significant gaps in data currently available. They found that detailed data are only available for deaths and injuries that result in a hospitalized inpatient stay. Injuries that are not treated in a hospital or are only treated in the emergency/outpatient department are not captured or reported through a central body. Furthermore, there is a large data gap for hospitalized injuries that require on-going care outside a hospital setting for either a short period or for a longer term of permanent disability.

Overall, the data gaps point towards two key analytical challenges:

- estimating the type, number and cost of non-hospitalized injuries
- building the full episode of care for hospitalized injuries resulting in short-term and long-term disabilities.

The analytic strategy used to address these methodological problems involved an extensive search through scientific literature to find numbers and ratios that could be used to fill the data gaps. For example, in an American study the researchers found a ratio of hospitalized to non-hospitalized injury. Since Canada has very good information on hospitalized injury available from the Canadian Institute of Health Information, the study researchers were able to apply this ratio to produce an estimate of the number and type of non-hospitalized injuries.

The ERAT: A Resource Tool

Meeting the second objective was entirely dependent on completing the first objective since the latter was essentially a test of the analytic tool at the national level. In order to enable the application of the tool at other levels, it was necessary to allow for the customization of some parameters in the analytical framework or spreadsheet to reflect local conditions (e.g., population size and mix, injury incidence, etc.) Once adjusted, the tool calculates total costs as well as costs for each injury type. The resource tool has been designed to allow for constant updating of current injury and cost information.

APPENDIX D

Methodology and Data Appendix

This study was conducted using an incidence costing approach. That is, the incident population of Saskatchewan residents injured in 1998 was costed over the lifetime of injured individuals. The costs, both direct and indirect, were discounted to a present value in 1998 at 3% per annum. Details on the incidence costing methodology are given in *The Economic Burden of Unintentional Injury in Canada*, pp. 15-20.

Mortality

Mortality data were provided by Saskatchewan Vital Statistics. The data file included external causes of death (ICD-9 E-codes), age and gender. Population denominators for the covered population were provided by Saskatchewan Health, by age and gender.

Mortality costs were restricted to indirect costs related to earnings lost due to death over what would have been the remaining working-life of individuals had they lived. Data from the Statistics Canada CANSIM database on participation rates, unemployment rates and average earnings was used in these calculations. A real wage growth rate of 1% per year was assumed.

Hospitalized Injuries

The Information Products Group, Corporate Information and Technology Branch, Saskatchewan Health, provided acute hospital separation data for all injury hospitalizations of Saskatchewan residents. The data included external causes of injury (ICD-9 E-codes), primary diagnosis (ICD-9 N-codes), length of stay, Resource Intensity Weight (RIW), age and gender.

Hospital costs were estimated using the average inpatient cost per weighted case,

provided by Saskatchewan Health, and the inpatient RIW. Medical and rehabilitation costs were calculated using hospital costs in conjunction with the distribution of ICD-9 N-codes by ICD-9 E-codes derived from CIHI hospital data, and Table 5.6 of the *Databook on Nonfatal Injury*. Indirect costs were limited to lost earnings during hospitalization.

Non-hospitalized Injuries

Non-hospitalized injuries were estimated using Saskatchewan hospitalized injuries in conjunction with the distribution of ICD-9 N-codes by ICD-9 E-codes derived from CIHI hospital data, and Table 4.3 of the *Databook on Nonfatal Injury*.

Medical and rehabilitation costs were calculated using the Saskatchewan hospital costs in conjunction with the distribution of ICD-9 N-codes by ICD-9 E-codes derived from CIHI hospital data, and Tables 5.6 and 5.9 of the *Databook on Nonfatal Injury*.

Disability

Partial permanent and total permanent disability from injury was estimated using both hospitalized and non-hospitalized injury in conjunction with the distribution of ICD-9 N-codes by ICD-9 E-codes derived from CIHI hospital data, and Tables 4.12 and 4.15 of the *Databook on Nonfatal Injury*.

Long-term medical costs were calculated using Saskatchewan hospital costs in conjunction with Tables 3.1 and 3.2 of the *Databook on Nonfatal Injury*, while the indirect cost associated with income loss was assumed to be 100% for total permanent disability, and 17% for partial permanent disability.

References

Miller, T.R., N.M. Pindus, J.B. Douglass and S.B. Rossman, Databook on Nonfatal Injury: Incidence, Costs and Consequences, The Urban Institute Press, Washington, D.C., 1995.

The Economic Burden of Unintentional Injury in Canada, The SMARTRISK Foundation, Toronto, ON, 1998.
