

Response to CAC Undertaking 1

AN ECONOMIC ANALYSIS OF CHILD PASSENGER SAFETY IN SASKATCHEWAN

Dr. Ian Pike

**Department of Paediatrics, University of British Columbia, BC Injury Research
and Prevention Unit**

Dr. Edi Desapriya

**Department of Paediatrics, University of British Columbia, BC Injury Research
and Prevention Unit**

Ms. Noreen Agrey

Saskatchewan Prevention Institute

Ms. Shannon Ell

Saskatchewan Government Insurance

Ms. Kelly Froehlich

Saskatchewan Ministry of Health

Ms. Michele Cairns

ABI Partnership Project, Ministry of Health, Saskatchewan

Ms. Kealee Playford

ABI Partnership Project, Ministry of Health, Saskatchewan

Ms. Kate Turcotte

BC Injury Research and Prevention Unit, University of British Columbia

ABSTRACT

The purpose of this study was to determine the cost-effectiveness of the Saskatchewan Child Passenger Safety Program: Do the program interventions lead to healthcare cost savings? Does the program result in a return on investment? Direct costs cover the range of cases from those who die at the scene or at home, die upon arrival at hospital, are dealt with completely in a hospital setting to those which encompass institutional, ambulatory, rehabilitation, home care and other related costs over long periods of recovery or, in extreme cases, during the remaining period of an individuals' life expectancy. Direct costs include coroner, hospital, ambulance, insurance and additional health care costs. Indirect costs are not included. Programming costs arise from SGI, the Saskatchewan Prevention Institute, and the Ministry of Health/ABI Partnership Project. Additive costs were based on standard methodology. The Saskatchewan Child Passenger Safety program costs total \$231,210 annually. Total direct costs decreased by a range of \$4.3M to \$8.2M within the pre-program period; and by a range of \$4.6M to \$8.6M during the program period. A range of cost reductions from \$39.2M to \$45.1M were calculated for the direct costs for child passenger injury and mortality medical care, comparing the program period to the pre-program period. A return on investment ranging from \$12 to \$16 of costs avoided for every \$1 invested in child passenger safety was found, with the caveat that the Child Passenger Safety program was not the only factor involved in increased child passenger safety in Saskatchewan.

RÉSUMÉ

INTRODUCTION

According to Transport Canada, 3,500 children are injured and 61 children are killed each year in motor vehicle crashes [1]. Motor vehicle crashes are the leading cause of childhood injury deaths and the second leading cause of hospitalization among children in Saskatchewan [2]. Among children ages 0 to 4 years specifically, motor vehicle crashes tie with fire and flame-related injury as the second leading cause of death after falls.

Policy makers are in need of better decision-making tools and more comprehensive information to assist them in allocating scarce resources more effectively in order to reduce this preventable injury. The purpose of this study is to determine if the Saskatchewan Child Passenger Safety Program is cost-saving in terms of child passenger injury, and if there is a return on investment.

METHODS

Injury Data

Injury data were provided by Saskatchewan Government Insurance (SGI) and the Saskatchewan Ministry of Health. The SGI Traffic Accident information System (TAIS) database contains all child passenger injuries, classified as minor, moderate (non-incapacitating), major (incapacitating), major (unconsciousness) and fatal. Assumptions were made based on the TAIS data that major injury cases may be those who were treated and released from an emergency room; and that moderate injury may be those who were attended by ambulance only. There is potential overlap in costs between hospitalization cases and those classified as emergency room only cases. Also, emergency room and ambulance only cases may be under-reported.

The Ministry of Health provided vital statistics data for both mortality data and hospitalizations. The mortality data provided contained lower numbers than seen in the TAIS data; therefore two separate calculations have been performed.

The hospitalization data may be an overestimation of child passenger injury, as a change in coding systems from the International Classification of Disease (ICD) version 9 to ICD-10 occurred in April, 2001. The numbers were flagged as records with any ICD-10-CA diagnosis code of V40 - V59 or ICD-9 diagnosis code of E810 - E819, E822 - E825. Child passengers injured while riding in a car, pick-up truck or van were the cases of interest, however those riding in heavy transport vehicles or buses (if any) could not be separated out from the data coded using ICD-9.

Direct Costs

Direct costs of child passenger injury are defined as the value of goods and services for which payment was made and resources used in treatment, care and rehabilitation related to illness or injury. In order to document the costs associated with child passenger injury, it is essential to have information on the complete episode associated with the events. This must cover the range of cases from those who die at the scene or at home, die upon arrival at hospital, are dealt with completely in a hospital setting to those which encompass institutional, ambulatory,

rehabilitation, home care and other related costs over long periods of recovery or, in extreme cases, during the remaining period of an individuals' life expectancy.

The direct cost components related to child passenger injury in this study are organized and divided into four mutually exclusive categories to reflect the severity of injury: (1) fatal injury; (2) injury resulting in hospitalization with survival to discharge; (3) injuries that were treated in a hospital emergency room and released without hospitalization; and, (4) injury and involvement in motor vehicle crashes resulting in ambulance attendance, not transferred to hospital. Within some of these categories, insurance costs covered by SGI and additional health care costs are also applied. The total direct cost of child passenger injury is estimated by the sum of the costs in these four 'severity of injury' categories.

Direct cost components included in this study for each severity category are listed in Table 1. Sources of costing information for each element are presented in Table 2. Dollar values were provided in 2010 dollars, and converted to the appropriate year using the Bank of Canada conversion calculator (<http://www.bankofcanada.ca/rates/related/inflation-calculator/>).

Costs	Fatal	Hospitalization	Emergency Room	Ambulance
Coroner	✓			
Hospital	✓	✓		
Emergency Room	✓	✓	✓	
Ambulance	*	*	✓	✓
Insurance	✓	✓		
Additional Direct Health Care Costs	✓	✓	✓	

*Ambulance costs for deaths and hospitalizations are covered by the SGI Insurance costs.

Table 1: Components of child passenger injury costs

Cost Source and Value	
Coroner	SK Coroners Service - \$1,748 per case • Approximately 1,800 death investigations a year divided by the 2011/12 annual budget of \$3,147,000 (Salaries: \$1,471,000; Goods & Services: \$1,676,000)
Hospital	Canadian Institute of Health Information (CIHI) - \$5,187 per case
Emergency Room	SK Ministry of Health -\$206 per case
Room	Operating budget for the Pasqua and RGH emergency departments combined in 2010-2011 was \$19,032,387, divided by 92,313 patients
Ambulance	SK Ministry of Health - \$490 per call • Average cost of an ambulance trip in SK for 2010-2011 based on total cost of road ambulance fee billings to patients divided by the total number of road ambulance trips for which a bill was generated
Insurance	SGI - \$140,000 per death; \$25,000 per hospitalization
Added Costs	<i>Economic Burden of Illness in Canada, 1998</i> , page 36: per capita cost for additional direct health care expenditures - \$943 in 1998 dollars (inflated to 2010 dollars)

Table 2: Child passenger injury costs sources and values in 2010 dollars

Indirect Costs

Indirect costs of child passenger injury can be calculated as the value of economic output lost because of illness, injury-related work disability, or premature death. These costs are not typically available for children less than 15 years of age, as they have yet to enter the workforce. Therefore, indirect costs are not included in this analysis.

Program Costs

Programming costs for child passenger safety in Saskatchewan arise from SGI, the Saskatchewan Prevention Institute, and the Ministry of Health/ABI Partnership Project, as presented in Table 3. The structure of these costs changed in 2008, increasing the SGI costs as funding for coordination was assumed, which was previously contained within the Saskatchewan Prevention Institute and the Ministry of Health/ABI Partnership Project budgets. The breakdown of child passenger safety program costs for SGI (since 2008) is provided in Table 4.

Item	Prior to 2008	Since 2008
SGI	\$154,996	\$227,996
Saskatchewan Prevention Institute - coordinator	\$20,000	
Ministry of Health/ABI Partnership Project – regional coordinator	\$20,000	
Ministry of Health/ABI Partnership Project – community grants	\$3,214	\$3,214
TOTAL	\$198,210	\$231,210

Table 3: Average annual Child Passenger Safety Program costs

Item	Annual Cost
Staffing costs	\$ 48,696
Advertising	\$ 86,000
Clinic supplies(brochures, window clings, check sheets, bags)	\$ 16,300
SK Prevention Institute Position	\$ 73,000
Insurance Brokers Association of SK sponsorship	\$ 4,000
TOTAL	\$227,996

Table 4: Annual Child Passenger Safety Program costs for SGI

Calculating Costs and Cost Reductions

Additive costs of child passenger injury were based on standard methodology. Total direct costs were calculated by multiplying the additive costs by the number of cases per year. As emergency and ambulance numbers are unconfirmed, costs were calculated as a range from zero cases accessing these services to all cases accessing these services.

It is important to note that based on the data availability, the pre-program period is 9 years in duration from 1988 to the end of 1996, while the program period is 14 years from 1997 to 2010. These periods are used for the program costing information.

However, while the program was initiated in 1997, in terms of injury data this start-up year has been included in the pre-program period, resulting in a 10-year span. The program period for the injury data therefore starts in 1998 once the program had been firmly established, resulting in a 13-year period.

The return on investment considers the declining injury rates, the current costs of child passenger injury and mortality, and the program costs. Calculations are made both excluding and including the estimated emergency room and ambulance costs.

RESULTS

Child Passenger Injury

There were a total of 55 child passenger fatalities during the pre-program period from 1988 to 1997, and 38 fatalities during the program period from 1998 to 2010 according to the TAIS data, for a total difference of 17 lives. These numbers were more dramatic during the program period

according to the vital statistics data, reporting 57 fatalities pre-program and 16 during the program period, for a total difference of 41 lives.

There were 831 hospitalizations due to child passenger injury in the pre-program period, and 456 in the program period, for a difference of 375. Emergency room visits were estimated at 295 pre-program and 131 program, for a difference of 164; and ambulance attended injuries were estimated at 1,341 pre-program and 557 during the program period, for a difference of 784.

Direct Costs

The mortality costs for child passenger injury were variable from 1988 to 2010, due to small numbers. Costs calculated using the TAIS data did not indicate a temporal trend; while costs calculated using the Vital Statistics data did indicate an overall downward trend. TAIS data indicate a high of \$2,992,005 in 1997 and a low of \$0 in 2006. The vital statistics data indicate a similar high of \$2,778,291 in 1997, but with lows of \$0 for 2003, 2006 and from 2008 to 2010.

Hospitalization, emergency room and ambulance costs for child passenger injury all indicated overall downward trends from 1988 to 2010. Hospitalization costs indicated a high of \$11,706,548 in 1988 and a low of \$3,548,928 in 2009. Emergency room costs reached a high of \$4,855,104 in 1988 and a low of \$726,081 in 2007. Ambulance costs ranged from a high of \$76,189 in 1988 to a low of \$12,026 in 2009.

The total child passenger direct costs indicated overall downward trends from 1988 to 2010, when using both the TAIS (Figure 1a) and the vital statistics (Figure 1b) mortality data. The rate of decrease in costs is seen to slow, as illustrated by the slope of the program period costs trend line (illustrated in blue and projected backward into pre-program period, Figures 1a and 1b) from 1997 to 2010 as compared to the pre-program costs trend line (illustrated in red and projected forward into program period, Figures 1a and 1b) from 1988 to 1997.

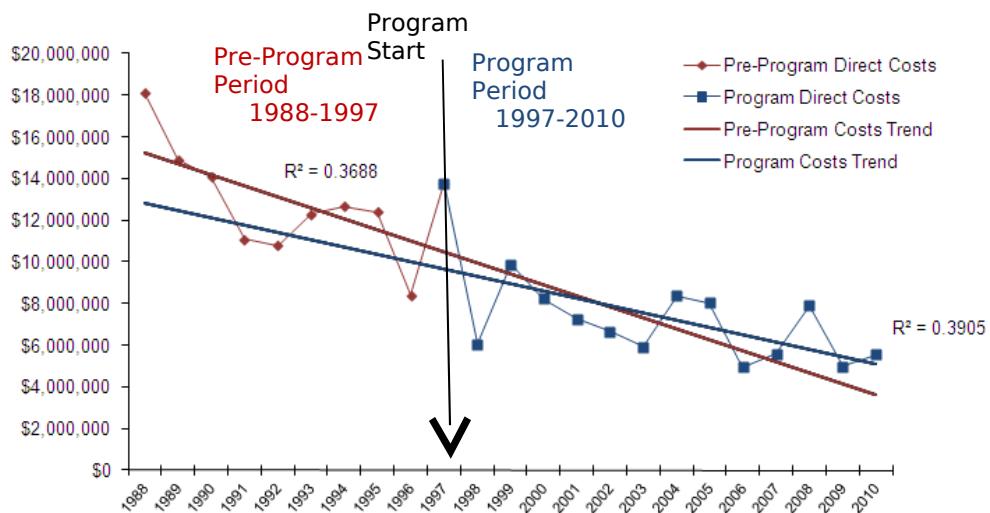


Figure 1a: Total direct costs, car, pick-up truck or van occupants, ages 0-12 years, SK, TAIS data 1988 – 2010.

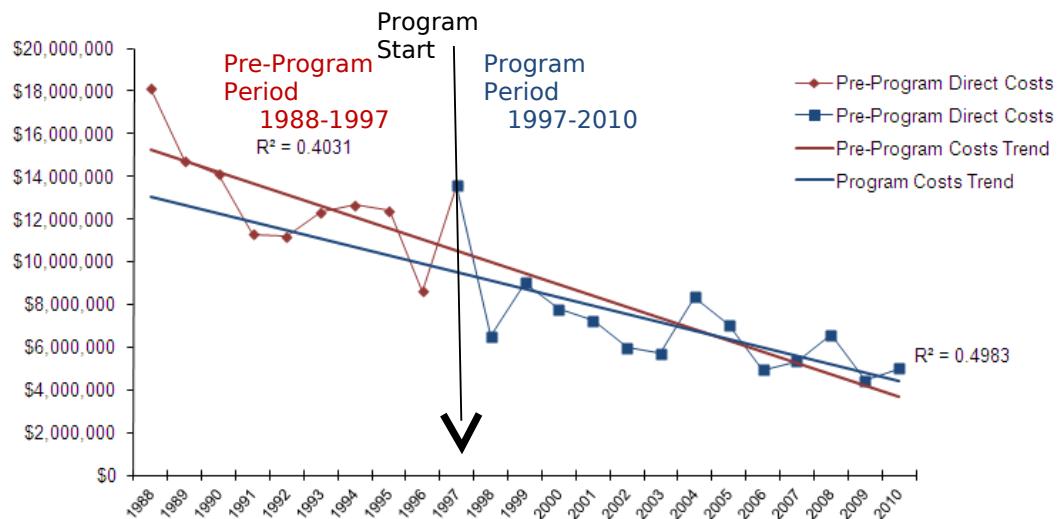


Figure 1b: Total direct costs, car, pick-up truck or van occupants, ages 0-12 years, SK, Vital Stats data 1988 – 2010.

Costs and Cost Reductions

Total injury costs for the pre-program period (1988 – 1997) and the program period (1998-2010) are presented in Table 5a (TAIS mortality data) and Table 5b (Vital Statistics mortality data). It is not possible to know if the pre-program period trends would have continued in the absence of the Child Passenger Safety Program. Total Child Passenger Safety program costs are presented in Table 6.

	Pre-Program Costs 1988-1997	Program Costs 1998-2010	Cost Reductions	Total Cases Pre	Total Cases Post	Change in Number	Reduction/Case
Injury Costs							
Death	\$10,830,928.91	\$9,135,199.65	\$1,695,729.26	55	38	17	\$99,748.78
Hospitalization	\$91,526,023.47	\$63,113,159.26	\$28,412,864.21	831	456	375	\$75,767.64
Emergency Department	\$25,771,535.65	\$16,890,020.66	\$8,881,514.99	295	131	164	\$54,155.58
Ambulance	\$437,301.16	\$240,335.27	\$196,965.89	1,341	557	784	\$251.23
Total Costs or Reductions	\$128,565,789.19	\$89,378,714.84	\$39,187,074.35	2,522	1,182	1,340	\$29,244.09

Table 5a: Total injury costs pre-program period and Child Passenger Safety program period, using TAIS mortality data.

	Pre-Program Costs 1988-1997	Program Costs 1998-2010	Cost Reductions	Total Cases Pre	Total Cases Post	Change in Number	Reduction/Case
Injury Costs							
Death	\$11,245,796.91	\$3,632,382.63	\$7,613,414.28	57	16	41	\$185,693.03
Hospitalization	\$91,526,023.47	\$63,113,159.26	\$28,412,864.21	831	456	375	\$75,767.64
Emergency Department	\$25,771,535.65	\$16,890,020.66	\$8,881,514.99	295	131	164	\$54,155.58
Ambulance	\$437,301.16	\$240,335.27	\$196,965.89	1,341	557	784	\$251.23
Total Costs or Reductions	\$128,980,657.19	\$83,875,897.82	\$45,104,759.37	2,524	1,160	1,364	\$33,068.01

Table 5b: Total injury costs pre-program period and Child Passenger Safety program period, using Vital Statistics mortality data.

	Program Costs 1997-2010
Community Grants	\$44,996.00
ABI Partnership Project Program Salaries	\$220,000.00
SK Prevention Institute Child Passenger Coordinator Salaries	\$220,000.00
SGI Annual Program Cost	\$2,388,944.00
Total Program Costs	\$2,873,940.00

Table 6: Total Child Passenger Safety Program costs 1997 – 2010.

An overall decrease in direct costs of \$4,335,120 was observed during the pre-program period from 1988 to 1997, averaging at \$481,680 per year using the TAIS mortality data (Figure 1a). The overall decrease in direct costs during the program period from 1997 to 2010 was observed to be \$8,225,029, with an average annual decrease of \$632,694. These numbers translate to \$4,568,835 and \$507,648, respectively for the pre-program period; and to \$8,559,148 and \$658,396 respectively for the program period, when using the Vital Statistics mortality data (Figure 1b).

Using the TAIS mortality data, total pre-program direct costs totalled \$128,565,789 while direct costs during the program period totalled \$89,378,715, for a difference of \$39,187,074 (Table 5a). Excluding the estimated emergency room and ambulance costs, these amounts decrease to \$102,356,952 and \$72,248,359 with a difference of \$30,108,593.

Using the Vital Statistics mortality data, total pre-program direct costs totalled \$128,980,657 while program costs totalled \$83,875,898, for a difference of \$45,104,759 (Table 5b). Excluding the estimated emergency room and ambulance costs, these amounts decrease to \$102,771,820 and \$66,745,542, with a difference of \$36,026,279.

Return on Investment

Reductions to child passenger injury and mortality are influenced by more than just the Child Passenger Safety Program. Improvements to: roads; vehicles; the child restraint systems themselves; driver behaviour such as speeding, driving under the influence, distracted driving; legislation and levels of enforcement and other factors have all contributed to the declining costs of child passenger injury and mortality. The magnitude of influence that this specific program plays in supporting these reductions is unknown, and therefore a true return on investment for the Child Passenger Safety Program is not possible.

Assuming that the Child Passenger Safety Program was solely responsible for decreasing child passenger injury and death; the return on investment ranges from 10.48:1 when excluding the estimated emergency room and ambulance costs, to 13.64:1 when including these costs, based upon the TAIS data for measuring child passenger mortality. Therefore, for every dollar invested in prevention, there are \$10 to \$14 in direct health care costs avoided.

This range for the return on investment for every dollar invested in prevention increases when based upon the Vital Statistics data for measuring child passenger mortality. In this case, the return on investment ranges from 12.54:1 when excluding the estimated emergency room and ambulance costs, to 15.69:1 when including these costs. Therefore, for every dollar invested in prevention, there are \$12 to \$16 in direct health care costs avoided.

The true return on investment for every dollar invested in the Child Passenger Safety program lies somewhere below these levels.

DISCUSSION

The program costs of the Saskatchewan child passenger safety model include costs to SGI, the Saskatchewan Prevention Institute, and to the Ministry of Health/ABI Partnership. Costs to SGI

include staffing costs including program coordination, advertising, materials and supplies, and Insurance Brokers Association of Saskatchewan sponsorship. Program co-ordination is shared between the Saskatchewan Prevention Institute and the Ministry of Health/ABI Partnership, and these costs were taken over by SGI in 2008. Costs to the Ministry of Health/ABI Partnership also include community grants. Total program costs are calculated to be \$231,210 annually.

Comparing the 13 years of data during the program period to the previous 10-year pre-program, there were 17 to 41 fewer deaths (according to TAIS vs. Vital Statistics mortality data), 375 fewer hospitalizations, an estimated 164 fewer emergency room visits, and an estimated 784 fewer ambulance attended child passenger injuries related to traffic collisions in Saskatchewan.

Within the pre-program period from 1988 to 1997, total direct costs decreased by a range of \$4.3M to \$8.2M (using the TAIS vs. Vital Statistics mortality data). These amounts average to \$482,000 to \$633,000 of costs avoided per year. Comparatively, during the program period from 1997 to 2010, these total direct costs avoided increased to a range of \$4.6M to \$8.6M, averaging \$508,000 to \$658,000 per year.

Comparing the program period to the pre-program period overall, the total direct costs of medical care for child passenger injury and mortality decreased by \$39.2M when using the TAIS mortality data. This increased to \$45.1M in total direct costs avoided using the Vital Statistics mortality data.

Taking a more conservative approach to calculating the direct costs by excluding estimates for emergency room and ambulance care, costs avoided of \$25.2M (TAIS mortality data) and \$36.0M (Vital Statistics mortality data) are still achieved.

An important consideration in the calculations of this economic burden of child passenger injury is that there are no indirect and intangible costs included, such as the monetary value of a child's life. For adults, one way to estimate the value of a life is to calculate potential income during their lifetime period. For example, for the families of victims of 9/11, compensation to families was primarily based upon likely future earnings and estimating the market price of lost services [3]. However, in this human capital method of valuation, a child's future earnings are discounted because the child is not currently productive and the value of his or her future earnings has not been established. Conversely, considering the sentimental value of children has lead to an increase in the economic value of a lost child. This controversial debate: devaluing a child's life versus profiting from a child's life has left this issue unresolved. Thus, indirect costs are not typically included for children. If indirect costs were included, the cost savings and return on investment would increase significantly.

A true return on investment for the Saskatchewan Child Passenger Safety Program cannot be calculated as there are a multitude of other factors that may be contributing to the declining costs in child passenger injury and mortality. These other factors include resources invested in improvements to roads, vehicle improvements, promoting improved driver behaviour, legislation and increased enforcement, improvements to health care, and other programming that may contribute to improving child passenger safety.

Furthermore, SGI TAIS data indicate that the proportion of minor and moderate MVC passenger injury among young children ages 0 to 4 years, where the child was either not restrained or improperly restrained, were already declining in the pre-program period. However, a higher rate

of decline occurred during the program period, although small numbers limited the ability to support this positive trend through statistical analysis [4]. It is important to note that there are no consistent data available describing the overall rates of proper child passenger restraint use over the study period, and that restraint use among children injured in motor vehicle crashes may not be representative of the whole population.

Assuming that the Child Passenger Safety program was the major contributing factor in the reduction of child passenger injury and death, the return on investment is in the range of \$12 to \$16 of costs avoided for every dollar invested in prevention. The true return on investment for every dollar invested in the Child Passenger Safety program lies somewhere below this range.

What is known about the effectiveness of child passenger safety initiatives is that the appropriate use of restraint systems is the single most effective means of reducing fatal and nonfatal injuries in motor vehicle crashes, and that child safety seat laws are the most effective intervention to increase child safety seat use [5]. The Saskatchewan Seat Belt Regulations have required that children less than 18 kilograms be restrained in an appropriate child restraint system at least since 1983 [6].

It is also known that improvements in behaviour become more difficult to achieve the higher the baseline of this behaviour in the population [7]. The continued downward trend of child passenger injuries and deaths from 1988 to 2010 – more than 20 years after child passenger safety legislation – as well as the continued decrease to total direct costs of child passenger injury, suggests that legislation alone is not responsible for this continued improvement. Further, evidence from conducting a systematic review of international best practices for improving child passenger safety supports the need for coupling differing types of interventions, such as legislation and enforcement reinforced with education and/or distribution [4]. An example of this is presented by Ekman et al., 2001, looking at the long-term effects of legislation and local promotion of child restraint use in Sweden [8]. Study communities who implemented an organized safety-promotion program showed greater improvement in child passenger restraint use following the child passenger safety legislation than the rest of Sweden. Further, education coupled with free safety seat distribution is one of the best practices to increase appropriate use of child safety seats recommended by a recent Cochrane systematic review [9].

CONCLUSION

Significant cost savings were found after the implementation of the Saskatchewan Child Passenger Safety Program. Although it is not possible to attribute all of these saving exclusively to the Child Passenger Safety program, there is strong evidence pointing towards its contribution to improvements of overall child passenger safety in Saskatchewan.

REFERENCES

1. SAFE KIDS CANADA. Child Safety Good Practice Guide: Good investments in unintentional child injury prevention and safety promotion. Canadian Edition, 2011.
<http://www.safekidscanada.ca/Professionals/Documents/34968-GoodPracticeGuide.pdf>
(Accessed Dec 20th, 2011).
2. MINISTRY OF HEALTH. Saskatchewan Comprehensive Injury Surveillance Report, 1995-2005. Government of Saskatchewan, Canada, 2008.
<http://www.health.gov.sk.ca/injury-report-1995-2005> (Accessed March 12, 2012).
3. ZELIZER, V.A. Pricing a Child's Life. Huffington Post, September 6, 2007.
http://www.huffingtonpost.com/viviana-azelizer/pricing-a-childs-life_b_63381.html.
(accessed March 6, 2010).
4. PIKE, I., DESAPRIYA, E., AGREY, N., ELL, S., FROEHLICK, K., CAIRNS, M., PLAYFORD, K., TURCOTTE, K. Assessment of a Child Passenger Safety Program. *Proceedings of the 23rd Canadian Multidisciplinary Road Safety Conference*, 2013.
5. ZAZA, S., SLEET, D.A., THOMPSON, R.S., SOSIN, D.M., BOLEN, J.C., TASK FORCE ON COMMUNITY PREVENTIVE SERVICES. Reviews of evidence regarding interventions to increase use of child safety seats. *Am J Prev Med* 21(4 Suppl):31-47, 2001.
6. GOVERNMENT OF SASKATCHEWAN. The Seat Belt Regulations (Repealed). Regina, Saskatchewan, 1997.
7. SHULTS, R.A., NICHOLS, J.L., DINH-ZARRC, T.B., SLEET, D.A., ELDER, R.W. Effectiveness of primary enforcement safety belt laws and enhanced enforcement of safety belt laws: A summary of the Guide to Community Preventive Services systematic reviews. *J Saf Res* 35:189–196, 2004.
8. EKMAN, R., WELANDER, G., SCANSTRÖM, L., SCHELP, L. Long-term effects of legislation and local promotion of child restraint use in motor vehicles in Sweden. *Accident Anal Prev* 33:793–797, 2001.
9. EHIRI, J.E., EJERE, H.O., MAGNUSEN, L., EMUSU, D., KING, W., OSBERG, J.S. Interventions for promoting booster seat use in four to eight year olds traveling in motor vehicles. *Cochrane Database Syst Rev* 25;(1):CD004334. 2006.