Estimating Minnesota Hospital Charge Savings with the Adoption of a Standard Enforcement Seat Belt Law

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Estimating Minnesota Hospital Charge Savings with the Adoption of a Standard Enforcement Seat Belt Law

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Executive Summary

Everyone pays the price for crashes and tax payers pay a considerable amount of the bill. In order to gain a better understanding of medical outcomes pertaining to crashes, a Crash Outcomes Data Evaluation System (CODES) project was implemented in Minnesota. Under CODES, individuals in crashes during 2002 were linked with hospital emergency room and inpatient treatment information. This report focuses both on hospital charges and direct medical costs for crashes that occur within the state. The impact crashes have on Minnesota's Medicaid program is also examined.

Safety belts have been found to be highly effective in preventing death and injury due to crashes. The National Highway Traffic Safety Administration (NHTSA) has found that three-point safety belts in frontal positions are 45 to 60 percent effective in preventing fatalities in frontal collisions and 50 to 65 percent effective in preventing moderate-to-critical injuries. Minnesota's observed safety belt usage rate for 2004 was at 82 percent. Although Minnesota is faring slightly better than the national average, by improving the state's seat belt use rate substantial progress can be made in lowering the number of deaths and injuries that result from crashes.

Increasing seat belt use in Minnesota would have a direct impact on lowering medical costs to government payer sources. A 1995 NHTSA study, *Safety Belt Use Laws: An Evaluation of Primary Enforcement and Other Provisions*, indicates that states with primary (or standard) enforcement safety belt laws achieved significantly higher belt use than did those with secondary enforcement laws. Based on the experience of other states, the Minnesota Office of Traffic Safety estimates that, by upgrading Minnesota's seat belt law in 2006, the seat belt use rate would increase from 84 to 94 percent.

If Minnesota were to upgrade its seat belt law to a standard enforcement law in 2006, the following cost savings projections (in 2006 dollars) can be made using 2002 CODES linked data:

After one year:

- Injuries prevented within the first year would save Medicaid $3.4 million in initial hospital charges and first-year costs.
- Injuries prevented within the first year would save $10.8 million in hospital charges regardless of payer source.

Cumulative savings from 2006 – 2015 by payer source:

- Medicaid would save $70.9 million
- Other government payer sources, excluding Medicaid, would save $14.3 million
- Commercial insurance would save $80.0 million
- Minnesota's Workers' Compensation Fund would save $0.75 million
- Other sources of payment, comprised principally of uninsured individuals paying their own medical bills directly, would save $23.8 million.

The cumulative cost savings over ten years for all payer sources using a weighted average effectiveness rate of 52.04 percent is nearly $190 million. Medicaid cost savings include long-term medical cost estimates for persons injured in crashes who sustained TBI and SCI. The most conservative cumulative estimate of hospital charge savings for upgrading Minnesota's belt law to standard enforcement was projected to be $108 million by 2015.

Introduction

The Burden of Motor Vehicle Crashes in Minnesota

As the leading cause of death for Minnesotans ages one through 34 in 2003, motor vehicle crashes are a public health epidemic.[1] Crashes are also the leading cause of death from unintentional injury for ages one to 64 and the primary cause of on-the-job death.[2, 3] Everyone pays the price for crashes and tax payers pay a considerable amount of the bill.

In 2004, there were 416 motor vehicle occupants killed and 36,408 injured in crashes on Minnesota's roadways.[4] The total economic cost for all of Minnesota's crashes in 2004 is estimated to be $2.5 billion.[5] (This compares to the $1.8 billion in economic costs calculated using methods provided by the National Safety Council.[6]) Cost estimates include such things as costs for medical care, emergency services, rehabilitation, lost productivity, legal services, workplace losses, and insurance administration.[7] This includes both fatal and nonfatal injuries as well as crashes involving property damage only.

Of the $2.5 billion in total economic costs for Minnesota in 2004, $310 million (12 percent) were related to medical services. Commercial insurers pay the majority of these medical costs. However, a substantial burden also falls on public sources such as the Medicaid, Medicare, and Worker's Compensation systems.

For the United States, the economic cost of motor vehicle crashes in 2000 was $230.6 billion. Medical expenses totaled $32.6 billion and travel delay accounted for $25.6 billion. Public revenues paid for about nine percent of all motor vehicle crash costs; this cost tax payers $21 billion in 2000, the equivalent of over $200 in added taxes for every household. The failure of a substantial portion of the driving population to buckle up cost society $26 billion in easily preventable injury related costs.[8]

Crashes pose a significant burden on government services. Local and state governments respond to traffic crashes. The severity of a crash determines the number of responders and length of time personnel must spend at a crash site. The total cost for a crash continues to escalate as clean up occurs, crash reconstruction and analysis are performed, and litigation against government entities responsible for the roadway is fought. For instance, the City of St. Paul reports that, in 2004, 58 percent of its general liability claims were motor vehicle crash related. In the end, the tax payer bill can explode when crash victims are unable to pay for their medical care or become reliant on government programs due to the fact they are seriously injured and can no longer adequately provide for themselves and their families. Furthermore, the public continues to pay for crashes through higher insurance premiums and medical costs.

The Impact of Safety Belts

Safety belts have been found to be highly effective in preventing death and injury due to crashes. The National Highway Traffic Safety Administration (NHTSA) has found that three-point safety belts in frontal positions are 45 to 60 percent effective in preventing fatalities in frontal collisions and 50 to 65 percent effective in preventing moderate-to-critical injuries.[9] Of those killed and seriously injured in 2004 crashes, 52 percent of fatality victims and 33 percent of those seriously injured were reported as not wearing their seat belts.[10] These figures exclude motorcyclists, bicyclists, pedestrians, and others involved in motor vehicle crashes (MVC) for whom safety belt use does not apply.

Minnesota's observed safety belt usage rate for 2004 was at 82 percent.[11] This rate was two percentage points above the national rate of 80 percent.[12] Correspondingly, Minnesota's MVC fatality rate of 1.00 per 100 million vehicle miles traveled in 2004 was below the U.S. rate of 1.44.[13] Although Minnesota is faring slightly better than the national average, by improving the state's seat belt use rate substantial progress can be made in lowering the number of deaths and injuries that result from crashes.

In order to gain a better understanding of medical outcomes pertaining to crashes, a Crash Outcomes Data Evaluation System (CODES) project, funded by NHTSA, was implemented in Minnesota. Under CODES, individuals in Minnesota crashes during 2002 were linked with hospital emergency room and inpatient treatment information, the Traumatic Brain Injury Registry, and death certificate data. The linked data are referred to in this report as the 2002 CODES dataset. The project represents a collaborative effort among the Minnesota Departments of Health, Public Safety, and Transportation, the Minnesota Hospital Association (MHA) and the Emergency Medical Services Regulatory Board (EMSRB).

Medical Outcomes for MVCs in Minnesota

This report focuses both on hospital charges and direct medical costs (DMC) for crashes that occur within the state of Minnesota. The impact crashes have on the state's Medicaid program is also examined. Information on hospital patients treated and released from both emergency departments and inpatient care is collected by the MHA. Because there are not any personal identifiers collected by the MHA, databases were linked using software based on statistical theory known as probabilistic linkage.

Hospital patient data contain charges that were billed for the patient's initial hospital stay after a crash event occurred. The 2002 CODES dataset contains 26,942 linked crash and hospital records with hospital charges totaling $171.7 million. These charges reflect charges incurred not actual charges paid, and include such things as room and board, as well as lab, radiology and other ancillary charges. Charge data **do not** include the following:

- Care received at medical *clinics.*
- First responder or ambulance transport data.
- Physician fees, such as surgeons, for patient care received while being treated at a hospital.
- Prescriptions filled after leaving treatment.
- Data on Minnesota crashes where the victim(s) sought treatment at hospitals in a border state.

For most people injured in crashes, there are relatively few costs beyond the initial hospital stay. However, certain types of injuries that required inpatient care commonly result in post-discharge costs in the first and subsequent years. Examples of these additional costs may include rehabilitation, nursing home services, medication and pain management. This study focuses on two such injuries, traumatic brain injury (TBI) and spinal cord injury (SCI), for which there are data available about post-discharge costs.

Motor vehicle crashes are the leading cause of TBI. The National Institute of Neurological Disorders and Stroke reports that nationally half of all TBIs are due to transportation accidents.[14] For Minnesota, the Brain Injury Association of Minnesota reports that 32 percent of TBI are caused by MVC incidents. In a February 2005 letter to the Minnesota Senate Transportation Committee, the Brain Injury Association reported that the annual cost of acute care and rehabilitation in Minnesota for new cases of TBI is estimated at $200 million. Using these figures, it can be deduced that TBIs caused by crashes annually cost Minnesota $64 million in acute care and rehabilitation.

Special emphasis was placed on costs to the state's Medicaid system, but estimates of the costs to commercial insurers, other government payer sources, and Worker's Compensation were also calculated. For these payers, only the initial hospital charges were considered because information was not available about the percentage of injured persons whose post-discharge costs would be paid by each of these sources. Therefore, the medical charges associated with MVC-related hospitalizations for commercial insurers, other government payer sources, and Worker's Compensation are underestimated in this report.

Finally, an estimation of cost savings resulting from Minnesota upgrading its seat belt law from a secondary to a standard enforcement status is calculated. The cost savings for a standard (or primary) enforcement law were estimated over a ten-year period from 2006 to 2015. A ten-year time period was selected to illustrate that the medical charges resulting from MVCs continue to accumulate over time, but will not do so indefinitely. The average life expectancy for survivors of a TBI or SCI is more than ten years, so it can be reasonably assumed that some injuries that occur in 2006 will continue to result in medical costs in 2015.

Data Sources and Methods

Data Sources and Limitations

The primary data source for the analysis is the 2002 CODES linked dataset. Although the TBI/SCI Registry and the hospital discharge dataset have external cause of injury codes (E-codes), for the purposes of the analysis, only cases that linked to a crash report were used.

Although the 2002 CODES dataset was found to be representative of the crash database, the number of MVC occupants sustaining a nonfatal hospitalized TBI in the 2002 CODES data set is 19 percent less than the number of nonfatal hospitalized TBI hospital discharge data patient records that had E-codes in the range of E810-E819 (.0, .1, .8, .9), indicating MVC occupancy. Thus, the 2002 CODES dataset under represents the total number of nonfatal hospitalized TBI patient records that were originally coded as MVC occupant injuries. In addition, the 2002 CODES linked dataset does not yet contain TBI Registry diagnosis codes, which identify an additional 26 percent of MVC occupant nonfatal hospitalized TBI when linked with the hospital discharge data.

Defining Motor Vehicle Occupants Hospitalized by MVCs

For this report, analysis only included people who were motor vehicle occupants. Minnesota Department of Heath (MDH) staff estimated that less than one percentage point of all Minnesota crash victims are transported outside of Minnesota for hospital emergency care; however, the percent of serious injury cases may be higher in border areas such as northwestern and southwestern Minnesota. Because there are a number of Wisconsin crash victims who are transported into Minnesota for hospital emergency care, Wisconsin crash data were originally included within the CODES linked dataset; however, Wisconsin crash data were not used for the report.

An important variable in this analysis is seat belt use. Seat belt use was imputed for those cases where use was unknown. Lastly, cost savings were only calculated for those cases where the individual was not belted and the linked hospital record had an injury coded (versus a non-injury coded).

Definitions of TBI and SCI

Because there are credible data available about the long-term medical charges for traumatic brain and spinal cord injuries, a focus of this report is to quantify charges associated with these types of injuries. The Centers for Disease Control and Prevention (CDC) has developed case definitions for TBI and SCI based on the World Health Organization's International Classification of Diseases, Ninth Revision (ICD-9) systems (Tables 1 and 2).[15, 16] The case definitions used in this report are based on those published in CDC's *Central Nervous System Injury Surveillance Data Submission Standards – 2002*.[17]

Table 1. Case Definition for TBI

ICD-9 code(s)	Description
800.0-801.9	Fracture of the vault or base of the skull
803.0-804.9	Other and unqualified and multiple fractures of the skull
850.0-854.1	Intracranial injury, including concussion, contusion, laceration, and hemorrhage
950.1-950.3	Injury to the optic chiasm, optic pathways, and visual cortex
959.01	Head injury, unspecified

Table 2. Case Definition for SCI

ICD-9 code(s)	Description
806.0-806.9	Fracture of the vertebral column with spinal cord injury
952.0-952.9	Spinal cord injury without evidence of spinal bone injury

Table 3 outlines the case definitions, in terms of ICD-9 codes, for the four levels of injury severity used in this report to determine the medical charges associated with SCI. These definitions were obtained from the National Spinal Cord Injury Statistical Center (NSCISC) and noted in a report from the Kentucky Transportation Center.[18]

Table 3. Case Definitions for Levels of SCI Severity

Injury severity	Definition	ICD-9 codes
High quadriplegia	Injury to C1-C4	806.00-806.04, 806.10-806.14, 952.00-952.04
Low quadriplegia	Injury to C5-C7	806.05-806.09, 806.15-806.19, 952.05-952.09
Paraplegia	Injury to T1-S5	806 (.2-.7), 952 (.1-.4)
Incomplete motor function at any level	-	806.8, 806.9, 952.8, 952.9

Within the 2002 CODES dataset, 1,569 motor vehicle occupants had a TBI diagnosis with hospital charges totaling over $30.4 million. A little more than one-third of all TBI cases were not wearing a seat belt and their charges comprised 46 percent of total charges. The average non-belted TBI had hospital charges that were 52 percent greater than a belted TBI case. Of the 65 individuals with a TBI that died, 52 percent were not wearing a seat belt.

With respect to SCI cases, there were 45 occupants with charges totaling just over $4 million. Forty (40) percent of SCI cases were not wearing a seat belt and their charges comprised nearly 40 percent of total charges. The average acute care charge for an unbelted SCI case was $86,095 and the average for a belted SCI case was $95,866. Of the four SCI victims that died, three were not wearing a seat belt.

Medical Costs to Medicaid

Hospital charge data include coding for a primary or expected source of payment, such as Medicaid or commercial insurance, as well as secondary and tertiary payment sources. The primary payer was used to determine who would pay the first-year medical costs. Patient records with Medicaid as the primary payer source were selected.

The model used to estimate MVC medical costs to Medicaid is partially based on methodologies used by Chaudhary and Preusser and the Kentucky Transportation Center; they utilized three categories of injury (TBI, SCI and other) and two time frames (first-year costs, which include initial hospital charges and first-year post-discharge costs, and additional-year costs).[19, 20]

To more accurately calculate TBI charges to Medicaid, unbelted Minnesota crash victims who sustained a TBI and lived were divided into three categories: 1) inpatients discharged into inpatient rehabilitation; 2) inpatients who had a discharge status other than inpatient rehabilitation; and 3) patients who were only treated within the emergency room. For discharges that did not involve a TBI or SCI diagnosis, only the initial hospital charges were considered (Table 4).

Table 4. Data Sources for Medical Charges of Injuries of TBI patients to Medicaid

Type of injury	First Year		Additional Year Charges
	Initial hospital charges	Post-discharge charges	
TBI patients discharged from inpatient care to inpatient rehabilitation	2002 CODES Dataset	Craig Hospital	Chaudhary and Preusser
TBI patients discharged from inpatient care to a status other than inpatient rehabilitation	2002 CODES Dataset	Chaudhary and Preusser	Chaudhary and Preusser
TBI patients discharged from emergency room services	2002 CODES Dataset	Not available	Not available
SCI	NSCISC	NSCISC	NSCISC
Other	2002 CODES Dataset	Not available	Not available

Calculating TBI Charges to Medicaid

Initial hospital charges were calculated from the Minnesota 2002 CODES dataset. Initial hospital charges represent the charges that were *billed to a payer*, which are generally somewhat higher than the actual sum paid. Of the 1,569 vehicle occupants diagnosed with TBI, 60 cases had Medicaid listed as the

primary payer source with charges totaling over $1.5 million. Of these 60 Medicaid cases, 42 percent were not wearing a seat belt; their charges comprised 61 percent of total charges to Medicaid. Non-belted TBI cases with Medicaid as the primary payer source had charges on average that were 80 percent greater than belted TBI cases.

To estimate post-discharge first-year costs for TBI patients, information was used from two sources: a release by Craig Hospital and a report issued by the Preusser Research Group. Craig Hospital estimated that TBI patients discharged from inpatient rehabilitation have an average post-discharge first-year cost of $40,348.[21] Additional year costs are derived from a study released by the Preusser Research Group which calculated average additional-year costs for TBI patients as being $26,871 a year.[22]

With these definitions and assumptions, first-year and long-term medical charges for Minnesota TBI crash victims from 2006-2015 were calculated. First-year cost savings projections for the three TBI subcategories are shown in Table 5.

Inpatient Rehabilitation Discharge

The first-year charges to Medicaid for TBI patients that were discharged from inpatient care into inpatient rehabilitation were estimated as the following:

$$CTBI_s = H_{TBI} + a * N_{TBI}$$

in which

$CTBI_s$ = TBI charges to Medicaid in first year

H_{TBI} = the initial hospital charges to Medicaid for TBI patients

N_{TBI} = the number of unbelted TBI victims on Medicaid who survived hospitalization

a = the first-year post discharge medical charges (estimated at $40,348 per TBI patient).

Not Discharged into Inpatient Rehabilitation

The first-year charges to Medicaid for TBI patients that were discharged from inpatient care into anything other than inpatient rehabilitation were estimated as the following:

$$CTBI_s = H_{TBI} + b * N_{TBI}$$

in which

$CTBI_s$ = TBI costs to Medicaid in first year

H_{TBI} = the initial hospital charges to Medicaid for TBI patients

N_{TBI} = the number of unbelted TBI victims on Medicaid who survived hospitalization

b = the first-year post discharge medical charges (estimated at $26,871 per TBI patient).

Emergency Room Treated Only

For TBI patients discharged from emergency room (ER) services, only initial hospital charges were used in first-year costs. There was not sufficient evidence to project the number of ER

treated TBI victims that will be in need of follow up care or the amount in which those services would cost.

To calculate the additional-year costs savings to Medicaid, the same calculation was used for both of the inpatient TBI subsets (additional year cost savings were not calculated for patients who received ER services only). According to the Craig Institute, the percentage of TBI patients on Medicaid will double in the year following injury.[23] To calculate cost savings for each additional year after the first year the injury event occurred, we used:

$$CTBI_L = (2\, N_{TBI} * b)$$

in which

$CTBI_L$ = TBI charges to Medicaid in subsequent nine years

N_{TBI} = the number of unbelted TBI patients on Medicaid who survived hospitalization

b = the first-year post discharge medical charges (estimated at $26,871 per TBI patient)

The direct medical cost estimates to Medicaid for unbelted TBI patients are presented in Table 5.

Table 5. 2002 Unbelted TBI Medical Cost Estimates to Medicaid (in 2002 dollars)

Type of Injury	N	First Year (2002)		Each Additional Year Cost	**Sum 10 Years**
		Initial hospital charges	Post-discharge costs		
TBI patients discharged from inpatient care to inpatient rehabilitation	1	$95,716.02	$40,348.00	$53,742.00	$619,742.02
TBI patients discharged from inpatient care to a status other than inpatient rehabilitation	8	$830,135.19	$214,968.00	$429,936.00	$4,914,527.19
TBI patients discharged from emergency room services	15	$34,488.99	NA	NA	$34,488.99

Initial hospital charge data are from 2002 and additional-year cost estimates are based on studies using pre-2002 cost data, with adjustments for inflation. Health care inflation rates for 2003-2006 were obtained from R-C Healthcare Management (through the Minnesota Hospital Association) and are shown in Table 6.

Table 6. Health Care Inflation Rates 2003-2006

Year	Inflation Rate	Net Operating Revenue
2003	5.8%	Historical
2004	5.0%	Historical
2005	4.5%	Projected
2006	4.2%	Projected

Using the figures from the last column in Table 5, Table 7 projects cost savings for unbelted TBI patients in 2006 dollars.

Table 7. Unbelted TBI Medical Charge Estimates to Medicaid for Injuries that Occurred in 2002, over a Ten-Year Period, Adjusted for Inflation

Type of Injury	Sum 10 Years	2003 Inflation 5.8%	2004 Inflation 5.0%	2005 Inflation 4.5%	**2006 Inflation 4.2%**
TBI patients discharged from inpatient care to inpatient rehabilitation	$619,742.02	$655,687.05	$688,471.41	$719,452.62	**$749,669.63**
TBI patients discharged from inpatient care to a status other than inpatient rehabilitation	$4,914,527.19	$5,199,569.77	$5,459,548.26	$5,705,227.93	**$5,944,847.51**
TBI patients discharged from emergency room services	$34,488.99	$36,489.36	$38,313.82	$40,037.95	**$41,719.54**

Calculating SCI and Other Injury Charges to Medicaid

NSCISC reports that average SCI charges per patient range from $201,273 to $682,957 in the first year and from $14,106 to $122,334 in each additional year depending on injury severity. The estimates of first-year SCI charges in Table 8 include the initial hospital charges; thus, the hospital charges from the 2002 CODES database were not used.[24]

Table 8. Average Yearly Charges for SCI, by Severity (in May 2004 dollars)

Injury severity	First year	Each subsequent year
High Quadriplegia	$682,957	$122,334
Low Quadriplegia	$441,025	$50,110
Paraplegia	$249,549	$25,394
Incomplete motor function at any level	$201,273	$14,106

Within the 2002 CODES dataset, there was only one SCI patient that was an unbelted, nonfatal vehicle occupant; Medicaid was listed as the first payer source. This patient suffered a high quadriplegia injury. Thus, the charge figure (Table 8) for high quadriplegia first-year charges of $682,957 was used.

In order to calculate additional-year charges to Medicaid for persons who experienced a SCI in a given year, it was also necessary to estimate the number of injured persons whose long-term medical expenses would be paid by Medicaid. According to the Craig Institute, 25 percent of all persons who experience an SCI will become Medicaid patients.[25]

The additional-year charges to Medicaid for SCI patients were estimated as the following:

$$CSCI_L = \sum (e_i * 0.254 * T_{(SCI)i})$$

in which

$CSCL_L$ = the charge to Medicaid in each year subsequent to the injury

e_i = the average expenses in each subsequent year for each SCI severity level (Table 8)

$T_{(SCI)i}$ = the number of unbelted MVC related SCI patients in each severity level who survived the initial hospitalization.

Charge estimates for the average long-term expenses to Medicaid for unbelted MVC SCI patients by severity categories are listed in Table 9. The last column takes the equation for calculating additional year charges listed above and multiplies it by nine years.

Table 9. Average Long-term Expenses to Medicaid for 2002 Unbelted MVC SCI Patients by Severity (in May 2004 dollars)

Injury Severity	N	Each Subsequent Year Cost Per Patient	25.4% of Total Cost of SCI Patients Over 9 Years
High Quadriplegia	3	$122,334.00	$838,966.57
Low Quadriplegia	4	$50,110.00	$458,205.84
Paraplegia	7	$25,394.00	$406,354.79
Incomplete motor function at any level	1	$14,106.00	$32,246.32
		Total SCI charges	$1,735,773.52

For unbelted vehicle occupants that did not have a diagnosis of TBI or SCI, cost projections were restricted to the initial hospital charges and are referred to in this report as "other." There is no available research to project medical charges post discharge of the initial hospital stay for these injuries. Table 10 captures the estimated first-year and additional-year charges for SCI patients and other injuries.

Table 10. Unbelted SCI and Other Patient Medical Cost Estimates to Medicaid (in 2002 Dollars) For One Year of Injury Prevention

Type of injury	N	First Year		Additional Year Charges	Additional Year Charges Over 9 Years	**Sum 10 Years**
		Initial hospital charges	Post-discharge charges			
SCI	See Table 9	-	682,957.00	$192,863.72	1,735,773.52	$2,418,730.52
Other	205	902,495.00	NA	NA	NA	$902,495.00

Inflation adjustments were made for SCI and other injuries as listed in the table below. Because SCI charge estimates were made with 2004 dollar figures, adjustments were only made to them for 2005 and 2006.

Table 11. 2002 Unbelted SCI and Other Medical Charge Estimates to Medicaid (in 2006 Dollars)

Type of injury	Sum 10 Years	2003 Inflation 5.8%	2004 Inflation 5.0%	2005 Inflation 4.5%	**2006 Inflation 4.2%**
SCI	$2,418,730.52	-	-	$2,527,573.39	**$2,633,731.47**
Other	$902,495.00	$954,839.71	$1,002,581.70	$1,047,697.87	**$1,091,701.18**

Calculating Medicaid Savings by Increasing Seat Belt Use

To calculate a savings estimate to Medicaid by increasing seat belt use, the total estimated charges for unbelted TBI, SCI, and other injured vehicle occupants were combined from the last columns of Tables 7 and 11. The charge savings to Medicaid for injuries that occurred in 2002, by ten years post adoption of the law upgrade, totaled $10.5 million.

Using 2002 CODES data, a weighted average effectiveness rate of 52.04 percent was calculated for preventing nonfatal injuries. MAIS injury scores were not taken into consideration when making this calculation. To project cost savings to Medicaid if all unbelted crash victims had worn their seat belt, the effectiveness rating of 52.04 percent was applied to the total cost estimate of unbelted crash victims. Table 12 provides an estimated cost savings to Medicaid for injuries that would be avoided over the course of one year if Minnesota's seat belt use rate were at 100 percent.

Table 12. Estimated Savings to Medicaid for Injuries Avoided the First Year After Minnesota's Seat Belt Use Rate was at 100 percent

Total charges to Medicaid for 2002 unbelted vehicle occupants (totals from Tables 7 and 11)	$10,461,669
Safety belt effectiveness rate	52.04%
Estimated savings if 100% seat belt use rate	$5,444,253

As of 2005, Minnesota's seat belt use rate is reported at 84 percent. Based on the experience of other states, the Minnesota Office of Traffic Safety estimates that Minnesota's seat belt use rate would rise from 84 percent to 94 percent if the seat belt law were upgraded to standard enforcement. Table 13 includes the projected total cost savings to Medicaid if Minnesota had a seat belt use rate at 94 percent. To calculate savings at 94 percent, the expected percentage point increase of 10 was divided by the current non-belted use rate of 16 percentage points, multiplied by the total estimated savings at 100 percent belt use, $5.44 million. The total direct medical cost (DMC) savings to Medicaid for hospitalizations that occur *in 2006 alone* would be $3.4 million.

Table 13. Estimated Savings to Medicaid for Injuries Avoided the First Year After Minnesota's Seat Belt Law is Upgraded to Standard Enforcement

Estimated savings if 100% seat belt use rate	$5,444,253
Law upgrade expected belt use rate	94%
Projected cost saving with law upgrade	$3,402,658

Cumulative cost savings to Medicaid for a ten-year period, assuming passage of a seat belt law upgrade to standard enforcement in 2006, are presented in **Appendix 1**. To calculate first-year and each additional-year costs, totals were combined from Tables 5 and 10. These figures were then calculated in 2006 dollars. For 2006, there would be $3.4 million in DMC savings. In 2007, the savings would be $4.2 million: $3.4 million in first-year savings plus one additional-year savings of $0.82 million from hospitalizations that occurred in 2006. By 2008, there would be $12.6 million in cumulative DMC savings: $3.4 million in first-year savings for 2006, 2007 and 2008 plus three additional-year savings of $0.82 million from hospitalizations that occurred in 2006 and 2007. Over the remaining years, the accumulated savings would be $25.2 million by 2010 and $70.9 million by 2015.

Cumulative Savings to Other Payers

Other payer sources, such as Workers' Compensation, will benefit from a primary enforcement law. According to the Minnesota Department of Labor and Industry, from 1995-1999 crashes accounted for 27 percent of on-the-job fatalities. Overall, on-the-job crash injuries (fatal and non-fatal) at the national level comprise about 6.5 percent of all crash injuries.[26] Although "Workers' Compensation" was only listed as the primary payer source for one percent of linked records, it is estimated that on-the-job crashes occur at a much greater rate.

Commercial insurance is the leading payer source in Minnesota with 63 percent of hospital charges. Because Minnesota has mandated no-fault auto-insurance coverage, vehicle insurance providers pick up the first $20,000 in medical charges that are billed for crashes that occur. Remaining medical charges are paid by other payer sources, such as regular health insurance.

The second leading group of payer sources, with 19 percent of total charges, is "Other Sources" which is mostly made of people paying their own bills or "self pay." The third payer group "Other Government," which does not include Medicaid, is the primary payer source for 13 percent of charges that occur. The average "Other Government" hospital charges were found to be 89 percent greater than the average of all other payer sources combined (excluding Medicaid). Government payer sources, including Medicaid, were the primary payer source for more than $16 million in hospital charges (or 18 percent of charges that occurred to vehicle occupants). The average hospital charge billed to a government payer source was 60 percent greater than a non-government source. One-third of charges were for unbelted occupants.

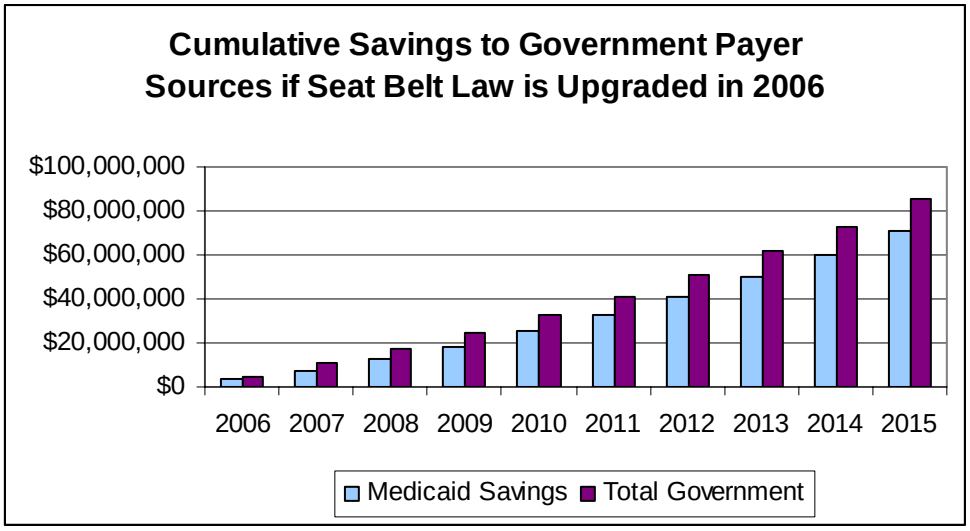
Using a simplified version of the methods used for Medicaid, savings were calculated for the other major sources of payment (**Appendixes 2-5**). The results are displayed in Table 14. These figures account only for charges related to the initial hospitalization because there is not information available to determine the number of injured occupants for which these payers would bear the post-discharge and long-term costs. Therefore, cumulative savings outlined in Table 14 can be considered minimum savings.

Table 14. Cumulative Medical Charge Savings for 2006-2015 for Payer Sources (in 2006 Dollars)

Payer	Savings in 2010 (in millions)	Savings in 2015 (in millions)
Commercial Insurance	$40.01	$80.01
Other sources (self pay)	$11.88	$23.76
Other Government (not including Medicaid)	$ 7.15	$14.30
Workers' Compensation	$0.37	$0.75

If Minnesota upgraded its seat belt law to standard enforcement in 2006, the cumulative charge savings to all government payer sources is projected to be $85.2 million by 2015. Figure 1 illustrates the cumulative savings to all government payer sources with Medicaid savings highlighted.

Figure 1. Cumulative Savings to Government Payer Sources if Seat Belt Law is Upgraded in 2006.



Refined Effectiveness of Seat Belts

Seat belts improve an occupant's chance of surviving a potentially fatal crash by 45 to 73 percent. In moderate-to-serious nonfatal injuries, they reduce the chance of injury by 44 to 78 percent.[27] The effectiveness of belts varies depending on circumstances surrounding a crash event, such as the following:

- Injury severity (moderate-to-serious injury versus fatality);
- Type of vehicle in which the occupant is riding (passenger car versus light truck);
- Type of safety belt used (lap belt only versus lap and shoulder belt); and
- Position of the occupant in the vehicle (front seat belt versus rear seat).

To determine savings using a refined methodology, vehicle occupants who had an injury-related diagnostic code were selected by the criteria listed above. In addition, only vehicle occupants within a passenger car (including SUVs) or a light truck were included in these analyses.

CODES data from 2002 revealed that only 24 percent of vehicle occupant fatality victims meeting the above criteria were discharged as deceased from hospitals. Examining Minnesota's Fatality Analysis Reporting System (FARS) data, it was found that 58 percent of 2002 fatalities were reported as dying at the scene of the crash.[28] For the people who died on the roadway or while in transport (59 percent of which were unbelted), there is no medical charge data as these cases only linked to death certificate records.

Of those treated at the hospital, there were 18,512 occupants with charges totaling $88.5 million. Twenty-two percent of these people were not wearing a seat belt and their charges comprised 36 percent of total charges. On average, unbelted occupants had charges 94 percent greater than belted occupants.

Table 15 provides information on potential savings specific to unbelted vehicle occupant fatalities. The NHTSA efficiency rates estimate charges avoided and lives saved had all unbelted occupants instead chosen to secure their seat belt. In addition, an estimate is provided for charges avoided (in 2002 dollars) and lives saved over the course of one year assuming that Minnesota upgraded its seat belt law and the belt use rate was at 94 percent.

Table 15. Estimated Medical Charges Avoided (in 2002 Dollars) and Lives Saved Over One Year if Minnesota's Seat Belt Use Rate was at 100 and 94 Percent

Vehicle Type	Seating Position and Belt Type Available	Total Number Killed	Number Killed & Hosp. Treated	Total Acute Care Charges	NHTSA Efficiency Rates[29]	Estimated Charges Saved if 100% Belted	Estimated Lives Saved if 100% Belted
Passenger Car	Front, Lap/ shoulder belt	177	34	$1,029,947	45%	$463,476.35	80
	Front, Lap belt only	1	0	$2,029	35%	$710.19	0
	Back, Lap/shoulder belt	18	4	$155,551	44%	$68,442.34	8
	Back, Lap belt only	7	3	$75,654	32%	$24,209.32	2
Light Truck	Front, Lap/shoulder belt	73	15	$581,299	60%	$348,779.56	44
	Front, Lap belt only	2	2	$29,201	50%	$14,600.70	1
	Back, Lap/shoulder belt	5	0	$0	73%	$0.00	4
	Back, Lap belt only	0	0	$0	63%	$0.00	0
Total Charges and Lives Saved at 100% Seat Belt Usage						**$920,218**	**138**
Total Charges and Lives Saved at 94% Seat Belt Usage						**$575,137**	**86**

Tables 16 and 17 provide information on potential savings specific to unbelted vehicle occupants that survived and had a diagnosed injury. NHTSA efficiency rates estimate injuries prevented and charges avoided had all unbelted occupants instead chosen to secure their seat belt. Table 16 contains data concerning moderate-to-critical injuries with a MAIS score of 2 through 5. Table 17 contains data concerning minor injuries with a MAIS score equal to one. Applicable NHTA efficiency rates were used. In addition, an estimate is provided for charges avoided (in 2002 dollars) and injuries prevented over the course of one year assuming that Minnesota upgraded its seat belt law and the belt use rate was at 94 percent.

Table 16. Estimated Medical Charges Saved (in 2002 Dollars) and Nonfatal Hospital-Treated Moderate to Critical Injuries (MAIS=2-5) Prevented Over One Year if Seat Belt Use Rate was at 100 and 94 Percent

Vehicle Type	Seating Position and Seat Belt Type	Number	Total Acute Care Charges	NHTSA Efficiency [30]	Estimated Charges Saved if 100% belted	Injuries Prevented if 100% Belted
Passenger Car	Front, Lap/shoulder belt	786	$17,602,071	50%	$8,801,035.47	393
	Front, Lap belt only	5	$150,758	30%	$45,227.45	2
	Back, Lap/shoulder belt	90	$1,073,626	49%	$526,076.60	44
	Back, Lap belt only	25	$416,630	37%	$154,153.14	9
Light Truck	Front, Lap/shoulder belt	247	$4,806,190	65%	$3,124,023.78	161
	Front, Lap belt only	4	$9,914	55%	$5,452.81	2
	Back, Lap/shoulder belt	6	$173,855	78%	$135,607.21	5
	Back, Lap belt only	3	$68,193	68%	$46,371.53	2
Total Charges and Injuries Prevented at 100% Seat Belt Usage					**$12,837,948**	**617**
Total Charges and Injuries Prevented at 94% Seat Belt Usage					**$8,023,718**	**386**

Table 17. Estimated Medical Charges Saved (in 2002 Dollars) and Hospital-Treated Minor Injuries (MAIS=1) Prevented Over One Year if Minnesota's Seat Belt Use Rate was at 100 and 94 Percent

Veh-icle Type	Seating Position and Seat Belt Type	Number	Total Acute Care Charges	NHTSA Efficiency [31]	Estimated Charges Saved if 100% belted	Injuries prevented if 100% belted
Pass-enger Car	Front, Lap/shoulder belt	1987	$3,887,714	10	$388,771.41	199
	Front, Lap belt only	10	$11,952	10	$1,195.19	1
	Back, Lap/shoulder belt	267	$358,658	10	$35,865.84	27
	Back, Lap belt only	58	$66,473	10	$6,647.34	6
Light Truck	Front, Lap/shoulder belt	494	$939,503	10	$93,950.27	49
	Front, Lap belt only	32	$26,012	10	$2,601.19	3
	Back, Lap/shoulder belt	25	$27,054	10	$2,705.37	3
	Back, Lap belt only	12	$8,552	10	$855.19	1
Total Charges and Minor Injuries Prevented at 100% Seat Belt Usage					**$532,592**	**289**
Total Charges and Minor Injuries Prevented at 94% Seat Belt Usage					**$332,870**	**180**

In 2002, 906 people were treated for motor vehicle crash injuries who would not have required hospital care had a seat belt been worn. Another 138 lives would have been saved had all been properly belted. The excess and preventable hospital charges for these unbuckled motor vehicle occupants in 2002 were more than $14 million. The estimated hospital charge savings for a 94 percent belt use rate (from Tables 16, 17 and 18) equals $8,931,724 (in 2002 dollars). To adjust for inflation, calculation rates in Table 6 were used. The adjusted hospital charge savings after one year of upgrading the seat belt law is $10,804,241 (in 2006 dollars).

Using the same methods as applied for calculating cumulative cost saving for payer sources, cost savings were calculated for overall effectiveness of seat belts (**Appendix 6**). These figures account only for charges related to the initial hospitalization because there is no information available to determine the number of injured occupants for which these payer(s) would bear the post-discharge and long-term costs. The estimated cumulative medical charge savings for upgrading Minnesota's seat belt law to standard enforcement would be $54 million by 2010 and $108 million by 2015.

Conclusions

Increasing seat belt use in Minnesota will lower medical costs to government payer sources. A 1995 NHTSA study, *Safety Belt Use Laws: An Evaluation of Primary Enforcement and Other Provisions*, indicates that states with primary enforcement safety belt laws achieved significantly higher belt use than did those with secondary enforcement laws. Upgrading the seat belt law would be the most effective and efficient means of increasing seat belt use in Minnesota. Based on the experience of other states, the Minnesota Office of Traffic Safety estimates that, by upgrading Minnesota's seat belt law in 2006, the seat belt use rate would increase from 84 percent belt use to 94 percent use.

If Minnesota were to upgrade its seat belt law to a standard enforcement law in 2006, the following cost savings projections (in 2006 dollars) can be made using 2002 CODES linked data:

After one year:

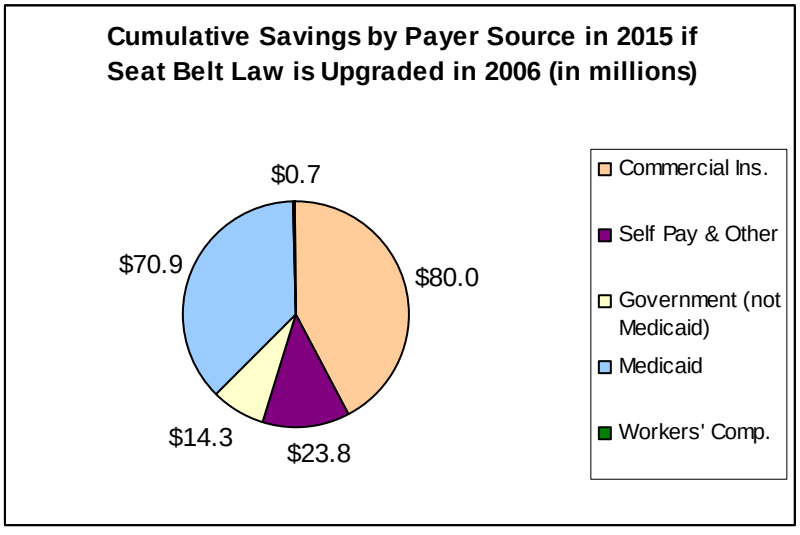
- Injuries prevented within the first year would save Medicaid $3.4 million in initial hospital charges and first-year costs.
- Injuries prevented within the first year would save $10.8 million in hospital charges regardless of payer source.

Cumulative savings from 2006 – 2015 by payer source:

- Medicaid would save $70.9 million
- Other government payer sources, excluding Medicaid, would save $14.3 million
- Commercial insurance would save $80.0 million
- Minnesota's Workers' Compensation Fund would save $0.75 million
- Other sources of payment, comprised principally of uninsured individuals paying their own medical bills directly, would save $23.8 million.

The cumulative cost savings over ten years for all payer sources using a weighted average effectiveness rate of 52.04 percent is nearly $190 million (**Figure 2**). Medicaid cost savings include long-term medical cost estimates for persons injured in crashes who sustained TBI and SCI. The most conservative cumulative estimate of hospital charge savings for upgrading Minnesota's belt law to standard enforcement was projected to be $108 million by 2015.

Figure 2. Cumulative Savings by Payer Source in 2015 if Seat Belt Law is Upgraded in 2006 (in millions)



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Appendix 1
Cumulative Charge Savings to Medicaid

Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
	Year 1	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**	**Year 7**	**Year 8**	**Year 9**	**Year 10**
2002	$3,402,657.95	$818,377.28	$818,377.28	$818,377.28	$818,377.28	$818,377.28	$818,377.28	$818,377.28	$818,377.28	$818,377.28
2003		$3,402,657.95	$818,377.28	$818,377.28	$818,377.28	$818,377.28	$818,377.28	$818,377.28	$818,377.28	$818,377.28
2004			$3,402,657.95	$818,377.28	$818,377.28	$818,377.28	$818,377.28	$818,377.28	$818,377.28	$818,377.28
2005				$3,402,657.95	$818,377.28	$818,377.28	$818,377.28	$818,377.28	$818,377.28	$818,377.28
2006					$3,402,657.95	$818,377.28	$818,377.28	$818,377.28	$818,377.28	$818,377.28
2007						$3,402,657.95	$818,377.28	$818,377.28	$818,377.28	$818,377.28
2008							$3,402,657.95	$818,377.28	$818,377.28	$818,377.28
2009								$3,402,657.95	$818,377.28	$818,377.28
2010									$3,402,657.95	$818,377.28
2011										$3,402,657.95
Total saved per year	$3,402,657.95	$4,221,035.23	$5,039,412.51	$5,857,789.79	$6,676,167.07	$7,494,544.35	$8,312,921.63	$9,131,298.91	$9,949,676.19	$10,768,053.47
Saved cumulative	$3,402,657.95	$7,623,693.18	$12,663,105.69	$18,520,895.48	$25,197,062.55	$32,691,606.90	$41,004,528.53	$50,135,827.44	$60,085,503.63	$70,853,557.10

Total = Projected acute care charge savings to Medicaid (MA) given a seat belt law upgrade and an expected belt use rate of 94%, based upon injuries occuring in 2002, adjusted for inflation to 2006 dollars.

DMC = direct medical charge savings; acute care charges based upon injuries occurring in 2002 and adjusted for inflation to 2006 dollars = $3,402,657.95

Long-term charge savings = the savings accrued due to charges prevented in follow-up and rehabilitative care = $818,377.28

Appendix 2
Cumulative Charge Savings to Commercial Insurance

Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
	Year 1	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**	**Year 7**	**Year 8**	**Year 9**	**Year 10**
2002	8,001,232									
2003		8,001,232								
2004			8,001,232							
2005				8,001,232						
2006					8,001,232					
2007						8,001,232				
2008							8,001,232			
2009								8,001,232		
2010									8,001,232	
2011										8,001,232
Total saved per year	8,001,232	8,001,232	8,001,232	8,001,232	8,001,232	8,001,232	8,001,232	8,001,232	8,001,232	8,001,232
Saved cumulative	$8,001,232.00	$16,002,464.00	$24,003,696	$32,004,928	$40,006,160	$48,007,392	$56,008,624	$64,009,856	$72,011,088	$80,012,320

Appendix 3
Cumulative Charge Savings to Other Government (Not including Medicaid)

Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
	Year 1	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**	**Year 7**	**Year 8**	**Year 9**	**Year 10**
2002	1,430,204									
2003		1,430,204								
2004			1,430,204							
2005				1,430,204						
2006					1,430,204					
2007						1,430,204				
2008							1,430,204			
2009								1,430,204		
2010									1,430,204	
2011										1,430,204
Total saved per year	1,430,204	1,430,204	1,430,204	1,430,204	1,430,204	1,430,204	1,430,204	1,430,204	1,430,204	1,430,204
Saved cumulative	$1,430,204.00	$2,860,408.00	$4,290,612	$5,720,816	$7,151,020	$8,581,224	$10,011,428	$11,441,632	$12,871,836	$14,302,040

Appendix 4
Cumulative Charge Savings to Other Payer Sources (Self Pay, Others, and Unknowns)

Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
	Year 1	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**	**Year 7**	**Year 8**	**Year 9**	**Year 10**
2002	2,375,879									
2003		2,375,879								
2004			2,375,879							
2005				2,375,879						
2006					2,375,879					
2007						2,375,879				
2008							2,375,879			
2009								2,375,879		
2010									2,375,879	
2011										2,375,879
Total saved per year	$2,375,879.00	$2,375,879.00	$2,375,879	$2,375,879	$2,375,879	$2,375,879	$2,375,879	$2,375,879	$2,375,879	$2,375,879
Saved cumulative	$2,375,879.00	$4,751,758.00	$7,127,637	$9,503,516	$11,879,395	$14,255,274	$16,631,153	$19,007,032	$21,382,911	$23,758,790

Appendix 5
Cumulative Charge Savings to Workers' Compensation

Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
	Year 1	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**	**Year 7**	**Year 8**	**Year 9**	**Year 10**
2002	74,979									
2003		74,979								
2004			74,979							
2005				74,979						
2006					74,979					
2007						74,979				
2008							74,979			
2009								74,979		
2010									74,979	
2011										74,979
Total saved per year	$74,979.00	$74,979.00	$74,979	$74,979	$74,979	$74,979	$74,979	$74,979	$74,979	$74,979
Saved cumulative	$74,979.00	$149,958.00	$224,937	$299,916	$374,895	$449,874	$524,853	$599,832	$674,811	$749,790

Appendix 6
Overall Cumulative Charge Savings Using Refined Effectiveness Methodology

Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
	Year 1	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**	**Year 7**	**Year 8**	**Year 9**	**Year 10**
2002	10,804,241									
2003		10,804,241								
2004			10,804,241							
2005				10,804,241						
2006					10,804,241					
2007						10,804,241				
2008							10,804,241			
2009								10,804,241		
2010									10,804,241	
2011										10,804,241
Total saved per year	10,804,241	10,804,241	10,804,241	$10,804,241	$10,804,241	$10,804,241	$10,804,241	$10,804,241	$10,804,241	$10,804,241
Saved cumulative	10,804,241	21,608,482	32,412,723	43,216,964	54,021,205	64,825,446	75,629,687	86,433,928	97,238,169	108,042,410