U.S. Department
of Transportation
**National Highway
Traffic Safety
Administration**

NHTSA
www.nhtsa.gov

DOT HS 811 067

December 2008

Estimated Medical Cost Savings in Massachusetts By Implementing a Primary Seat Belt Law

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
DOT HS 811 067		

4. Title and Subtitle	5. Report Date
Estimated Medical Cost Savings in Massachusetts by Implementation of a Primary Seat Belt Law	December 2008
	6. Performing Organization Code
7. Author(s)	8. Performing Organization Report No.
Neil Chaudhary, Julie Tison	
9. Performing Organization Name and Address	10. Work Unit No. (TRAIS)
Preusser Research Group, Inc. 7100 Main Street Trumbull, CT 06611	
	11. Contract or Grant No. DTNH22-05-D-15043
12. Sponsoring Agency Name and Address	13. Type of Report and Period Covered
U.S. Department of Transportation Office of Behavioral Safety Research National Highway Traffic Safety Administration 1200 New Jersey Avenue SE. Washington, DC 20590	
	14. Sponsoring Agency Code

15. Supplementary Notes

16. Abstract

This report examines 2006 hospital discharge data reporting cases where the external cause of injury to a vehicle occupant was a motor vehicle crash to predict the estimated savings to Massachusetts if a primary seat belt law is implemented. The savings are calculated using costs based on the report Economic Impact of Motor Vehicle Crashes (DOT HS 809 446). In Massachusetts, there is an expectation of a primary law reducing the burden of insurance companies by about $55.8 million from crashes occurring in a single year alone. The crash victims in Massachusetts would benefit by a reduction of more about $3.9 million while the Federal Government would also reduce its costs by about $3.9 million before reimbursing Massachusetts for a portion of Medicaid expenditures. Massachusetts would also reduce its spending by $5.7 million ($3.6 million after reimbursement).

22. Key Words	18. Distribution Statement
Seat belt Laws Costs	

19. Security Classif.(of this report)	20. Security Classif.(of this page)	21. No. of Pages	22. Price
Unclassified	Unclassified	12	

INTRODUCTION

> On Saturday April 8, 2006, at 8:29 a.m., a 17-year-old male was involved in a crash on Bardwell Street in South Hadley, Massachusetts. The driver of the other vehicle was a 16-year-old male. The 17-year-old man, unbelted, was killed in the crash. The 16-year-old was uninjured in the crash. He was belted.
>
> On Tuesday February 7, 2006, at 11:45 a.m., an 18-year-old female was driving on Blackstone Street in Uxbridge, Massachusetts, when she struck another vehicle. The other vehicle was driven by a 69-year-old man. The 18-year-old woman, belted, did not suffer any injury. The 69-year-old man, unbelted, was completely ejected from the vehicle and died. His 65-year-old female passenger, belted, survived.
>
> On Thursday, December 14, 2006, at 9:29 a.m., a 68-year-old female was driving on State Route 27 in Hanson, Massachusetts, when she was involved in a crash. The other vehicle was driven by a 34-year-old female. The 34-year-old woman, properly restrained, was uninjured in the crash. Her two passengers, a 2-year-old girl and a 5-year-old boy, were in child safety seats and suffered no injury. The 67-year-old woman, unbelted, was killed in the crash.

Seat belts can reduce the risk of death for front-seat occupants of passenger cars by 45%. Similarly, belt use reduces the risk of serious non-fatal injuries by 50% for front seat occupants of passenger cars. Belts are associated with a 65% decreased risk of injury while in light trucks (SUVs, minivans, and pickup trucks).[1]

There are two types of seat belt laws. "Primary" seat belt laws allow police officers to enforce a violation of a seat belt law after observing a belt use infraction by itself. That is, the police can treat a seat belt violation as they would any other violation. "Secondary" laws prevent police from enforcing the belt law unless it is observed in association with another violation. That is, if the belt violation is the only visible infraction, police are not allowed to enforce the law in a secondary law State.

According to NHTSA, the passage of primary seat belt laws would likely induce 40% of current nonusers to wear seat belts. One study by the National Safety Council estimated that if all States had primary laws from 1995 to 2002 more than 12,000 lives would have been saved.[2]

Additionally, there are real financial costs to a secondary law State. These costs associated with failure to implement a primary seat belt law are dispersed to the State's budget in terms of Medicaid and other State medical expenditures, the individual residents of the State injured in crashes, private insurance companies and Federal Government. This study estimates the *minimum* dollars saved, including direct medical costs (primarily paid through Medicaid), by the implementation of a primary seat belt law in Massachusetts.

METHODS

Medical Cost Estimates

Values from Massachusetts's 2006 Hospital Discharge data were used to estimate the complete medical costs of such motor vehicle related injuries. This data includes diagnosis and cost information, payer information, and status at discharge (e.g., deceased) for each person discharged from Massachusetts's hospitals. For diagnoses that describe injuries, there are also "E-codes" which describe the external cause of the injuries. E-codes can indicate whether the cause of the injury was a motor vehicle crash and whether the person injured was an occupant of a motor vehicle. It should be noted that "in theory" every injury diagnosis should have an associated E-code, but this is rarely the case. Using this information we identified which patients were occupants of motor vehicles (excluding motorcycles) and received injuries as a result of a crash.

The costs listed in the database represent only the tip of the iceberg in terms of total medical costs from injuries. Often, especially with more severe injuries, there are extensive medical costs incurred after the hospitalizations. There are likely follow-up medical visits, future surgeries, and even rehabilitation. As such, hospital costs may grossly underestimate actual medical costs for injuries. We therefore use estimated medical costs provided by Blincoe et al.[3] These estimates, calculated specifically for injuries associated with motor vehicle crashes, include lifetime costs for the specific injuries associated with a crash. For each level of injury severity in the Maximum Abbreviated Injury Scale (MAIS), costs are estimated for specific body parts. The MAIS identifies the severity of the worst injury (noting that individuals may have multiple injuries) on a scale of 0 to 6. Zero indicates no injury, 1 is minor injury, up to 5 is severe injury, and 6 is not survivable (or fatal) injury. Using diagnosis codes we are able to map injuries to specific body parts but discharge data do not indicate the severity of injury. Therefore we used the distribution of injury severity by body part for MAIS 1 to 5 (excluding fatal injuries) to calculate an average cost per body part. The distribution was calculated by the National Center for Statistical Analysis using an average distribution from 2002 to 2006 Crashworthiness Data System (CDS). Fatal injuries were excluded because they have no future medical costs and therefore actual hospital charges are used.

According to the Bureau of Labor Statistics medical costs have increased 35% from 2000 to 2007. We therefore adjusted the Blincoe et al. costs by this amount to make them better reflect 2009 medical costs. Table 1 shows the final estimated costs per body region in 2006 dollars. These estimates were used to calculate costs of motor vehicle crash related injuries in Massachusetts.

Additional adjustments are necessary to make the estimates more reflective of actual medical costs. E-codes do not identify whether a hospital patient is an occupant of a passenger vehicle or a large truck. Primary seat belt laws would not be expected to affect injuries sustained to occupants of large trucks. Therefore we used the proportion of large trucks in NHTSA's Fatality Analysis Reporting System (FARS), a census of all fatal crashes on public roadways in the United States, to estimate the proportion of hospitalizations in the State that were likely occupants of large trucks and

remove them from the analyses. Specifically, the General Estimate System 2006 data (GES, 2006) indicates that nationally, the proportion of all fatally injured occupants who were in large trucks and buses is the same as the proportion of all non-fatally injured occupants who were in large trucks and buses (4% for both). In Massachusetts there were 1.4% of the fatal injuries who were occupants of non-passenger vehicles. Therefore we reduced costs by this amount to account for those injuries likely to stem from large trucks.

Table 1. Costs and Injury Distribution by Body Part**

	Body Part													
	Brain		Other Head/Neck/Face		SCI		Trunk, Abdomen		Upper Extremities		Lower Extremities		Other	
MAIS	%	Cost	%	Cost	%	Cost	%	Cost	%	Cost	%	Cost	%	Cost
1	6%	$41,047	21%	$1,597	0%	*	17%	$1,685	24%	$1,160	12%	$1,735	100%	$1,465
2	27%	$42,286	29%	$16,227	0%	*	24%	$15,368	32%	$7,412	29%	$11,599	0%	*
3	22%	$261,610	30%	$75,801	25%	$479,361	34%	$44,134	44%	$23,320	43%	$42,198	0%	*
4	22%	$278,899	13%	$240,685	39%	$1,113,597	19%	$71,500	0%	*	11%	$55,989	0%	*
5	23%	$378,308	6%	$124,344	36%	$1,470,010	6%	$85,005	0%	*	5%	$282,991	0%	*
M	$221,596		$66,772		$1,086,910		$37,723		$12,862		$41,795		$1,465	

**No Injuries of This Severity*

*** Source: NCSA analysis of 2002-2006 CDS*

A second adjustment was also made to account for incomplete use of E-codes by hospitals. For all cases with an injury diagnosis in the first three diagnosis codes, we calculated the percentage of cases for which an E-code was excluded and adjusted our values by that amount. Two percent of cases in Massachusetts did not have an E-code. We assumed that the distribution of external cause of injury would be the same for cases in which the E-code was present and when it was not (i.e., E-codes are excluded randomly across all injury sources).

Finally, adjustments were made for charges paid by the State since the Federal Government repays a portion of the State's Medicaid Costs. That is, some of the charges that the database indicates belong to the State (only the portion that are Medicaid), are moved to be charges for the Federal Government. That is, the Federal Government returns 50% of the Medicaid charges to Massachusetts and these costs become Federal Government expenditures.[4]

Estimates of Cost Reductions by Implementation of a Primary Seat Belt Law

Once we obtained a dollar value for motor vehicle injury costs, a determination of how much would be saved as a result of a new primary seat belt law was made. In order to accomplish this we need to estimate how much belt use would increase as a result of a primary seat belt law and how many fewer injuries would result from the increase in belt use.

Estimating Seat Belt Usage Increase From Primary Law

The estimate of seat belt use increase following primary law upgrade is based on NHTSA estimate of a 40% conversion rate. That is, NHTSA estimates that 40% of those who are non-seat-belt users will become seat-belt users following a change to primary law. Using this estimate we would expect Massachusetts's belt use among people hospitalized for injuries sustained in motor vehicle crashes to go from 66.8% to 80.1% (a 13.3-percentage-point increase).

Estimate Belt Use Effectiveness

Once we establish how many new people will be restrained we need to determine how many of these newly restrained individuals will benefit from seat belts. NHTSA has determined that the seat belt is roughly 50% effective for cars and 65% effective for light trucks.[1] These percentages are in terms of reduction of serious injury (MAIS 5 to 2). For less severe injuries (MAIS 1) the effectiveness is 10% in both vehicle types. Hospital discharge data cannot tell what vehicle type the victim was in. Therefore, we estimate the distribution of cars to light trucks using FARS. According to 2006 GES data, the ratio of cars to light trucks is the same for injuries as it is for fatalities (80% cars for both groups). Consequently, we used FARS to identify the proportion of cars to light trucks for the State. Given the proportion of cars to light trucks (and the proportion of injuries that are MAIS 1), the weighted average effectiveness was calculated to be 47%. The estimates of cost reduction assume that this percentage applies to those hospitalized as a result of motor vehicle crashes.

Calculating Savings

The savings calculations were based on an expected 13.3-percentage-point increase in seat belt use, and a 47% reduction in injury to those newly belted people. To turn the percentage point increase into a percentage we calculate what the cost would have been had no one been retrained and take 13.3% from that. The formula for this is:

$$Cost\ at\ 0\ belt\ use = \frac{C}{1 - UE}$$

Where C = current costs, U = current belt use, and E = the effectiveness of the belt (in this case 47%). This formula was applied to each payer. These values are then multiplied by the expected percentage-point increase and 47% (the estimated effectiveness of the belt) to determine the amount saved.

Results

There were a total of 4,610 motor-vehicle-crash-related patients discharged from Massachusetts hospitals in 2006 (101 of them were deceased). The actual cost of these crash-related injuries was $179,451,221 in direct hospital costs alone. Of that, $144,249,544 (80.4%) of the charges was billed to insurance companies. Another $5,365,511 (3.0%) was paid by the patients. The State of Massachusetts covered $19,011,315 (10.6%), primarily in Medicaid expenditures, and the Federal Government was charged $10,824,851 (6.0%, primarily through Medicare).

The dollar values increase when we estimate what they would be for all medical care associated with the vehicle crash. Overall, traffic crashes cost all payers in the State $757,332,880 for injuries occurring in a single year. The estimated costs also show that insurance companies cover the greatest amount for traffic-related injuries ($609,413,751, or 80.5%). Estimated charges for the State Government are $62,685,041 (8.3%) and are $42,937,789 (5.7%) for the Federal Government. Finally, people of Massachusetts who are crash victims can expect to pay $42,296,299 (5.6%) for all injuries to occupants of passenger cars stemming from crashes.

Some portion of these estimated costs are expected to decrease with the implementation of the primary seat belt law. In Massachusetts this decrease is expected to be 9.2%. The estimates of all cost results indicate that the greatest savings would be to insurance companies, which also have the greater part of the costs. There is an expectation of a primary law reducing the burden of insurance companies for injuries occurring in 2009 by $55,789,425 from crashes occurring in that year alone. The crash victims of Massachusetts would benefit by a reduction of $3,872,059 while the Federal Government would reduce its costs by $3,930,785. Massachusetts would also reduce its spending by about $5,738,568.

The Federal Government reimburses States for a portion of their Medicaid expenditures. The Medicaid portion of the Massachusetts costs would be $4,177,636 (leaving $1,560,933 as non-Medicaid costs). The Federal Government would reimburse Massachusetts about 50% of its Medicaid costs ($2,088,818). Thus, the State's net amount would decrease and the Federal Government's would increase. The last column of Table 2 shows what the post reimbursement costs would be to the State and the Federal Government.

Table 2. Costs by Primary Payer

Primary Payer	N Alive	N Dead	Actual Hospital Charges in 2006	Estimated Total Medical Costs for 2008	Saved By Primary	After Fed Gov't Reimbursement
Insurance	3,479	80	$144,249,544	$609,413,751	$55,789,425	
State Gov't (e.g., Medicaid)	305	5	$19,011,315	$62,685,041	$5,738,568	$3,649,750
Federal Government	419	14	$10,824,851	$42,937,789	$3,930,785	$6,019,603
Paid by MA Crash Victims	306	2	$5,365,511	$42,296,299	$3,872,059	
ALL	4,509	101	$179,451,221	$757,332,880	$69,330,838	

** Adjusted for E-Code Usage and Large Truck*

CONCLUSION

The estimates reported here are considered to be underestimations of savings associated with increased seat belt use associated with the implementation of a primary seat belt law. This study does not explore the peripheral costs (loss of wages and tax revenues, productivity, loss of life, etc.). Additionally, research has shown that the costs of unbelted injuries are 25% higher than belted injuries, and unbelted occupants are more likely to be Medicaid patients.[5] Additionally, Emergency Department (ED) data were unavailable for this time period. All those patients who were injured and discharged from the ED, or who died in the ED are excluded from this analysis.

There is also no attempt to project cost increases over time as far as what the savings would be in future years. Medical cost increases have traditionally far outpaced inflation. Costs reported here are merely small portions of the likely savings. Clearly, the State, its citizens, and other payers can expect to reduce other associated costs by implementation of a primary enforcement seat belt law. For example, unemployment is much higher among disabled persons, and family members frequently need to defer employment to become care takers. These costs not only reduce the tax base for the State but may also add to the number of people on other State-dependent funds (e.g., welfare). The savings to private business of the State are not estimated. Last, we do not attempt to place a price on human life, pain, or suffering.

All the costs in this study are based on conservative values. The goal was to produce a value that could be considered an absolute minimum value in that we chose to err on the conservative side when in doubt.

In summary, Massachusetts could expect to save at least about $5.7 million dollars ($3.6 million dollars after reimbursement) from injuries prevented in 2009 alone on its medical costs from the introduction of a primary seat belt law. The total savings to all payers will be about $69.3 million dollars.

References

1. Kahane, C. J. (2000). Fatality reduction by safety belts for front-seat occupants of cars and light trucks: Updated and expanded estimates based on 1986-99 FARS Data. Technical Report: DOT HS 809 199. Washington, DC: National Highway Traffic Safety Administration.

2. Chaudhary, N. K., & Preusser, D. F. (2003). Lives lost by states' failure to implement primary safety belt laws. Report to the National Safety Council. Itasca, IL: National Safety Council. Available: http://www.nsc.org/public/Preusser_Study.doc

3. Blincoe, L., Seay, A., Zaloshnja, E., Miller, T., Romano, E., Luchter, S., & Spicer, R. (May 2002). The Economic Impact of Motor Vehicle Crashes, 2000. NHTSA Technical Report DOT HS 809 446. Washington, DC: National Highway Traffic Safety Administration.

4. Federal Financial Participation in State Assistance Expenditures. Published in the Federal Register, Volume 71, No. 230, Thursday, November 30, 2006, pp. 69209-69211. Washington, DC: Department of Housing and Human Services. Available: http://aspe.hhs.gov/health/fmap08.htm

5. Gill, S. S., Jakub, J. W., Pease, M. C., & Woolen, C.D. (2002).The economic impact of motor vehicle crashes: The cost of restrained versus unrestrained occupants in South Carolina. *The American Surgeon*, 68, 569-574.

DOT HS 811 067
December 2008

U.S. Department
of Transportation
**National Highway
Traffic Safety
Administration**

www.nhtsa.gov