# Costs of Large Truck- and Bus-Involved Crashes

U.S. Department of Transportation
Federal Motor Carrier Safety Administration

December 2000

# FOREWORD

This study provides comprehensive, economically sophisticated estimates of the costs of highway crashes involving large trucks and buses by severity. Based on the latest data available, the estimated cost of police-reported crashes involving trucks with a gross weight rating of more than 10,000 pounds averaged $75,637 (in 1999 dollars). The average cost of police-reported crashes involving transit or inter-city buses was $54,455 per crash. These costs represent the present value, computed at a 4 percent discount rate, of all costs over the victims' expected life span that result from a crash. They include medically related costs, emergency services costs, property damage costs, lost productivity, and the monetized value of the pain, suffering, and quality of life that the family loses because of a death or injury.

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16. Abstract

**This study provides comprehensive, economically sophisticated estimates of the costs of highway crashes involving large trucks and buses by severity. Based on the latest data available, the estimated cost of police-reported crashes involving trucks with a gross weight rating of more than 10,000 pounds averaged $75,637 (in 1999 dollars). The average cost of police-reported crashes involving transit or inter-city buses was $54,455 per crash. These costs represent the present value, computed at a 4 percent discount rate, of all costs over the victims' expected life span that result from a crash. They include medically related costs, emergency services costs, property damage costs, lost productivity, and the monetized value of the pain, suffering, and quality of life that the family loses because of a death or injury.**

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# SI* (MODERN METRIC) CONVERSION FACTORS

## Table of APPROXIMATE CONVERSIONS TO SI UNITS

| Symbol | When You Know | Multiply By | To Find | Symbol |
|---|---|---|---|---|
| | | **LENGTH** | | |
| in | inches | 25.4 | millimeters | mm |
| ft | feet | 0.305 | meters | m |
| yd | yards | 0.914 | meters | m |
| mi | miles | 1.61 | kilometers | km |
| | | **AREA** | | |
| $in^2$ | square inches | 645.2 | square millimeters | $mm^2$ |
| $ft^2$ | square feet | 0.093 | square meters | $m^2$ |
| $yd^2$ | square yards | 0.836 | square meters | $m^2$ |
| ac | acres | 0.405 | hectares | ha |
| $mi^2$ | square miles | 2.59 | square kilometers | $km^2$ |
| | | **VOLUME** | Note: Volumes greater than 1000 L shall be shown in $m^3$ | |
| fl oz | fluid ounces | 29.57 | milliliters | mL |
| gal | gallons | 3.785 | liters | L |
| $ft^3$ | cubic feet | 0.028 | cubic meters | $m^3$ |
| $yd^3$ | cubic yards | 0.765 | cubic meters | $m^3$ |
| | | **MASS** | | |
| oz | ounces | 28.35 | grams | g |
| lb | pounds | 0.454 | kilograms | kg |
| T | short tons (2000 lb) | 0.907 | megagrams (or "metric ton") | Mg (or "t") |
| | | **TEMPERATURE** | Temperature is in exact degrees | |
| °F | Fahrenheit | 5 × (F-32) ÷ 9 or (F-32) ÷ 1.8 | Celsius | °C |
| | | **ILLUMINATION** | | |
| fc | foot-candles | 10.76 | lux | lx |
| fl | foot-Lamberts | 3.426 | candela/$m^2$ | $cd/m^2$ |
| | | **Force and Pressure or Stress** | | |
| lbf | poundforce | 4.45 | newtons | N |
| $lbf/in^2$ | poundforce per square inch | 6.89 | kilopascals | kPa |

## Table of APPROXIMATE CONVERSIONS FROM SI UNITS

| Symbol | When You Know | Multiply By | To Find | Symbol |
|---|---|---|---|---|
| | | **LENGTH** | | |
| mm | millimeters | 0.039 | inches | in |
| m | meters | 3.28 | feet | ft |
| m | meters | 1.09 | yards | yd |
| km | kilometers | 0.621 | miles | mi |
| | | **AREA** | | |
| $mm^2$ | square millimeters | 0.0016 | square inches | $in^2$ |
| $m^2$ | square meters | 10.764 | square feet | $ft^2$ |
| $m^2$ | square meters | 1.195 | square yards | $yd^2$ |
| ha | hectares | 2.47 | acres | ac |
| $km^2$ | square kilometers | 0.386 | square miles | $mi^2$ |
| | | **VOLUME** | | |
| mL | milliliters | 0.034 | fluid ounces | fl oz |
| L | liters | 0.264 | gallons | gal |
| $m^3$ | cubic meters | 35.314 | cubic feet | $ft^3$ |
| $m^3$ | cubic meters | 1.307 | cubic yards | $yd^3$ |
| | | **MASS** | | |
| g | grams | 0.035 | ounces | oz |
| kg | kilograms | 2.202 | pounds | lb |
| Mg (or "t") | megagrams (or "metric ton") | 1.103 | short tons (2000 lb) | T |
| | | **TEMPERATURE** | Temperature is in exact degrees | |
| °C | Celsius | 1.8C + 32 | Fahrenheit | °F |
| | | **ILLUMINATION** | | |
| lx | lux | 0.0929 | foot-candles | fc |
| $cd/m^2$ | candela/$m^2$ | 0.2919 | foot-Lamberts | fl |
| | | **Force & Pressure or Stress** | | |
| N | newtons | 0.225 | poundforce | lbf |
| kPa | kilopascals | 0.145 | poundforce per square inch | $lbf/in^2$ |

* SI is the symbol for the International System of Units. Appropriate rounding should be made to comply with Section 4 of ASTM E380.
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# LIST OF ABBREVIATIONS

| Acronym | Definition |
|---|---|
| AIS | Abbreviated Injury Score |
| BMCS | Bureau of Motor Carrier Safety |
| CDS | Crashworthiness Data System |
| CHAMPUS | Civilian Health and Medical Program of the Uniformed Services |
| DCI | Detailed Claims Information |
| FARS | Fatality Analysis Reporting System |
| FMCSA | Federal Motor Carrier Safety Administration |
| GES | General Estimate System |
| KABCO | a rating scale defining injury severity |
| MAIS | Maximum Abbreviated Injury Score |
| NASS | National Accident Sampling System |
| NHDS | National Hospital Discharge Survey |
| NHTSA | National Highway Traffic Safety Administration |
| NMES | National Medical Expenditure Survey |
| OIC | Occupant Injury Code |
| OST | Office of the Secretary of Transportation |
| PDO | property damage only |
| QALY | quality-adjusted life year |

# EXECUTIVE SUMMARY

This study provides comprehensive, economically sophisticated estimates of the costs of highway crashes involving large trucks and buses by severity. Based on the latest data available, the estimated cost of police-reported crashes involving trucks with a gross weight rating of more than 10,000 pounds averaged $75,637 (in 1999 dollars). The average cost of police-reported crashes involving transit or inter-city buses was $54,455 per crash. These costs represents the present value, computed at a 4 percent discount rate, of all costs over the victims' expected life span that result from a crash. They include medically related costs, emergency services costs, property damage costs, lost productivity, and the monetized value of the pain, suffering, and quality of life that the family loses because of a death or injury. Other notable findings include:

- The cost of crashes in which truck-tractors with two or three trailers were involved was the highest among all crashes—$117,309 per crash.
- Among crashes with all configuration information available, bus-involved crashes had the lowest cost—$54,455 per crash.
- The costs per crash with injuries averaged $217,005 for large truck crashes and $131,214 for bus crashes.
- As expected, fatal crashes cost more than any other crash. The average cost of fatal crashes involving truck-tractors with two or three trailers was the highest among all fatal crashes—$3.54 million per crash.
- The crash costs per 1,000 truck miles are $259 for single unit trucks, $138 for single combination trucks, and $134 for multiple combinations.
- The costs of large truck crashes in 1997 exceeded $24 billion. That total included $8.7 billion in productivity losses, $2.5 billion in resource costs, and quality of life losses valued at $13.1 billion.
- Bus crashes were a much smaller factor than truck crashes, costing less than $1 billion in 1997.
- The cost estimates exclude mental health care costs for crash victims, roadside furniture repair costs, cargo delays, earnings lost by family and friends caring for the injured, and the value of schoolwork lost.

# INTRODUCTION

Trucks and buses with a gross weight rating of over 10,000 pounds constitute the majority of interstate commercial vehicles. They are the primary focus of Federal Motor Carrier Safety Regulations. Crashes involving such vehicles impose a variety of costs on the vehicle and its driver, other drivers either directly or indirectly involved in the crash, and society as a whole. In addition to costs such as property damage, emergency services, and travel delays, injuries and fatalities impose significant costs. This report provides unit costs of large (medium and heavy) vehicle crashes, stated in 1999 dollars.

Safety analysts use crash cost data for a variety of purposes, from analyzing the effectiveness of a particular roadway enhancement to measuring the impact of seatbelt use. Crash costs are used to compare the relative efficacy of various crash countermeasures, which are expected to have a differential impact on crashes of different severity. These figures are also used to calculate and compare the cost-effectiveness of proposed safety regulations. Efficient allocation of research, enforcement, and analysis resources requires reliable data on crash costs.

Miller et al. (1991) made a first attempt to estimate truck and bus crash costs. They first computed costs by threat-to-life severity measured by Maximum Abbreviated Injury Score (MAIS; Association for the Advancement of Automotive Medicine, 1985). The Abbreviated Injury Score (AIS) scheme is a detailed medical classification developed by physicians as a basis for rating the survival threat injuries pose. It assigns a numeric rating ranging from 0 (uninjured) to 6 (maximum, generally unsurvivable). National Highway Traffic Safety Administration (NHTSA) data sets that are AIS coded add codes for “injured, severity unknown” and “unknown if injured.” MAIS is simply the maximum AIS among the multiple injuries a victim suffers. The purpose of the AIS scale is to differentiate injuries by survival threat, not the cost, functional losses, or course of recovery they involve. For example, loss of teeth is an AIS-1 injury that can involve substantial costs and lifetime pain and suffering. Conversely, timely surgery often allows complete and rapid recovery from ruptured spleens and other AIS 3-5 internal injuries. Nevertheless, average costs per case within a body region almost always rise with MAIS (Miller, 1993).

By multiplying average costs per highway crash victim by MAIS times the MAIS distribution of victims in crashes sorted by the heaviest vehicle involved, Miller et al. (1991) estimated costs by vehicle type. Those estimates implicitly assumed that the distribution of injuries by body region within an AIS severity level did not vary with vehicle type. Only property damage and crash-related travel delay costs were tailored to truck and bus crashes.

Miller, Levy, et al. (1998) and Miller et al. (1999) improved on Miller et al. (1991) by computing medium/heavy vehicle crash costs by vehicle type from 1982–1992 data on victim MAIS and body region in medium/heavy vehicle crashes. They also tailored the costs by victim age and sex. The present report parallels their methods. It updates their estimates and substantially increases the number of cases used to estimate the injury distribution for occupants of light passenger vehicles involved in medium/heavy vehicle crashes. With the larger sample, it is able to more finely differentiate costs among heavy vehicle types. Notably, the present study is the

first to differentiate costs of single versus multiple trailer crashes. Within the constraints of available data, it provides economically sophisticated, reliable estimates of the average costs of medium/heavy vehicle crashes with different levels of severity.

# METHODS

Estimating crash costs requires estimates of the number of people and vehicles involved in a crash, the severity of each person's injuries, and the costs of those injuries and associated vehicle damage and travel delay. The following section describes the methodology used to estimate the incidence and severity of large truck and bus crashes. The succeeding section explains how the costs of crashes were estimated.

***Incidence and Severity Estimation.*** To estimate injury incidence and severity, we followed procedures developed by Miller and Blincoe (1994) and Miller, Galbraith, et al. (1995) and also applied in Blincoe (1996), Miller, Levy, et al. (1998), Miller, Lestina, and Spicer (1998), and Miller et al. (1999). Our estimates of the average number of people and vehicles involved in a medium/heavy vehicle crash by vehicle type, restraint use, crash severity, and police-reported injury severity come from NHTSA's Fatal Analysis Reporting System (FARS) and General Estimates System (GES).

Crash databases do not accurately describe the severity of large truck and bus crashes. Accordingly, we made several adjustments to more accurately reflect the severity of crashes. These adjustments are described below.

FARS is a census of U.S. fatal crashes but it does not describe injuries to survivors in these crashes. GES provides a sample of U.S. crashes by police-reported severity for all crash types. GES records injury severity by crash victim on the KABCO scale (National Safety Council, 1990) from police crash reports. Police reports in almost every State use KABCO to classify crash victims as K – killed, A – disabling injury, B – evident injury, C – possible injury, or O – no apparent injury. KABCO ratings are coarse and inconsistently coded between States and over time. The codes are selected by police officers without medical training, typically without benefit of a hands-on examination. Some victims are transported from the scene before the police officer who completes the crash report even arrives. Miller et al. (1991) and Blincoe and Faigin (1992) documented the great diversity in KABCO coding across cases. O'Day (1993) more carefully quantified the great variability in use of the A-injury code between States. Viner and Conley (1994) explained the contribution to this variability of differing State definitions of A-injury. Miller et al. (1987) found police-reported injury counts by KABCO severity systematically varied between States because of differing State crash reporting thresholds (the rules governing which crashes should be reported to the police). Miller and Blincoe (1994) found that State reporting thresholds often changed over time.

Thus, police-reporting does not accurately describe injuries medically. To minimize the effects of variability in severity definitions between States, reporting thresholds, and police perception of injury severity, we turned to NHTSA data sets that included both police-reported KABCO and medical descriptions of injury in the Occupant Injury Coding system (OIC; Association for the Advancement of Automotive Medicine, 1985, 1990). OIC codes include AIS score and body region, plus more detailed type injury descriptors that changed from the 1985 to the 1990 edition. We used both 1988–1991 Crashworthiness Data System (CDS; NHTSA, 1995) and 1982–1986 National Accident Sampling System (NASS; NHTSA, 1987) data. CDS describes injuries to

passenger vehicle occupants involved in towaway crashes. The 1982–1986 NASS data provide the most recent medical description available of injuries to medium/heavy truck and bus occupants, non-occupants, and other non-CDS crash victims. The NASS data were coded with the 1980 version of AIS, which differs slightly from the 1985 version; but NHTSA made most AIS-85 changes well before their formal adoption. CDS data were coded in AIS-85 through 1992, then in AIS-90. We did not use CDS data after 1991 because AIS scores in AIS-90 differ greatly from scores in AIS-85, especially for brain and severe lower limb injury. Garthe et al. (1996) find that AIS scores shifted for roughly 25 percent of all OICs between AIS-85 and AIS-90. Because cost estimates by AIS-90 severity do not exist, we did not use CDS data from 1993 onward. We pooled all other available years of data in order to get sufficient cases for analysis by truck type.

We used 1988–1997 GES data to weight the CDS and NASS data so they represent the annual estimated GES injury victim counts in medium/heavy vehicle crashes by CDS and NASS sample strata. In applying these weights we controlled for police-reported injury severity, restraint use, and vehicle occupied (or non-occupant). Weighting the NASS data to GES restraint use levels updates the NASS injury profile to a profile reflecting contemporary belt use levels. Again, sample size considerations drove the decision to pool all available data. At the completion of the weighting process (Figure 1), we had a hybrid CDS/NASS file with weights that summed to the estimated annual GES incidence by police-reported injury severity and other relevant factors.

Trucks and buses with a gross weight rating of over 10,000 pounds were grouped into the following categories:

- Straight truck, no trailer.
- Straight truck with trailer.
- Straight truck, unknown if with trailer.
- Truck tractor with no trailer (bobtail).
- Truck tractor with one trailer.
- Truck tractor with two or three trailers.
- Truck tractor with unknown number of trailers.
- Medium/heavy truck, unknown if with trailer.
- All large trucks.
- Transit/inter-city bus.

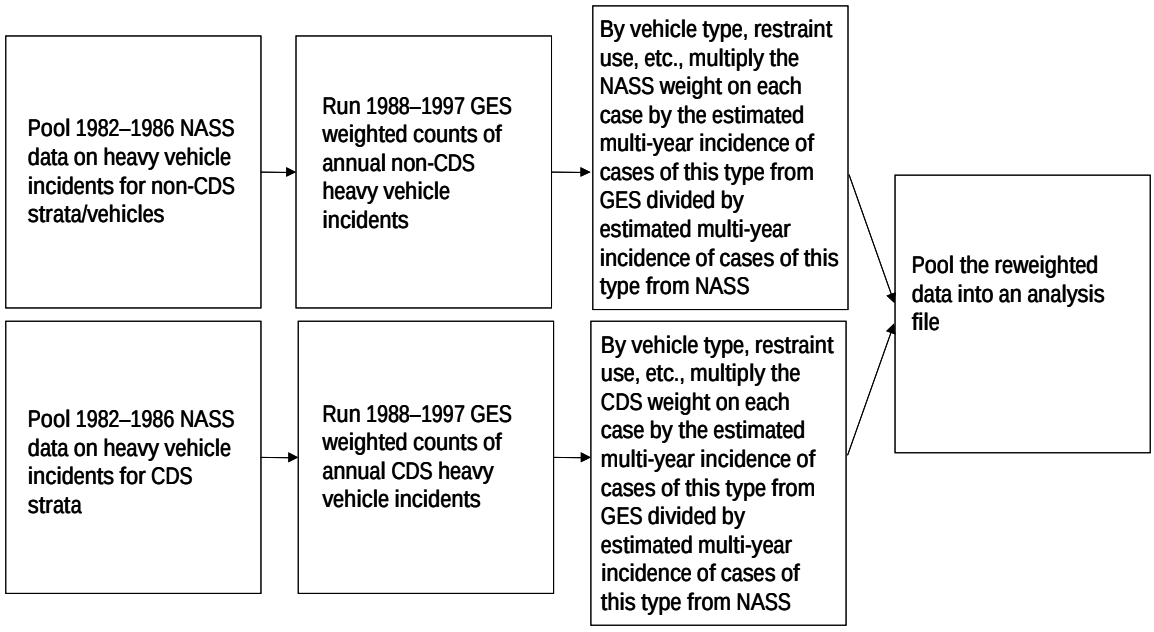


**Figure 1. The merger of NASS, CDS, and GES files**

In order to create reasonable sample sizes, two assumptions were made in the categorization of trucks/buses. Trucks that were reported in the GES and FARS data as medium/heavy trucks and had no trailing units were assumed to be straight trucks with no trailer. Trucks that were reported as unknown medium/heavy trucks and had more than one trailing unit were assumed to be truck tractors with two or three trailers.

In addition to the grouping based on the above assumptions, straight trucks with trailer and medium/heavy trucks with one trailer were grouped together because of a discrepancy between FARS and GES estimates. A count of fatal truck crashes based on FARS revealed that medium/heavy trucks with one trailer were involved in 131 fatal crashes between 1988 and 1997. The respective GES estimate was 742. On the other hand, FARS data suggested that straight trucks with one trailer were involved in 869 fatal crashes during the same period, as opposed to 176 estimated from GES data. Since FARS data are much more reliable than GES data—FARS represents a census of fatal crashes as opposed to GES, which is simply a modest sample—it was assumed that a good number of straight trucks with trailers were miscoded in the GES files as unknown medium/heavy truck with one trailer. Therefore, in absence of a reliable way of separating out the misrepresented cases, unknown medium/heavy trucks with one trailer were included in the category "straight truck with trailer."

***Cost Estimation.*** The second step required to estimate average crash costs is to generate estimates of crash costs by severity. This section describes the process used to develop these estimates. In order to estimate the average costs per crash by medium/heavy vehicle type and crash severity, costs per injury by MAIS and body region were adapted from the costs in Miller (1997) and Miller et al. (1999). These costs were merged onto the GES-weighted NASS/CDS file. The costs represent the present value, computed at a 4 percent discount rate, of all costs over

the victim's expected life span that result from a crash. We included the following major categories of costs:

- Medically related costs.
- Emergency services.
- Property damage.
- Lost productivity.
- Monetized Quality-Adjusted Life Years (QALYs).

The present study updated the medical cost estimates from Miller (1997) and adjusted its other cost estimates to comply with official U.S. Department of Transportation injury cost guidance and methods (McCormick & Shane, 1993; Krusei & McFadden, 1996). Notably, to obtain the present value of costs in future years, we re-estimated medical costs of severe brain and spinal cord injuries, productivity losses, and quality of life losses with a 4 percent discount rate rather than the 2.5 percent rate used in those studies. A higher (lower) discount rate would lower (raise) future costs, especially those that occur farther into the future.

**Medically Related Costs.**

These include hospital, physician, rehabilitation, prescription, and related payments. Also included are coroner and burial costs for fatalities, and claims processing costs of medically-related loss compensation through insurance and the courts (omitting time spent on the loss recovery process).

To update medical costs, we computed total medical costs of crashes in 1996, then used this aggregate information to adjust prior detailed cost estimates by MAIS and body region injured. The new estimate of total medical spending on crash victims used methods and data developed in a study of childhood injury costs (Miller, Romano, & Spicer, 2000) and in building the U.S. Consumer Product Safety Commission's Injury Cost Model (Lawrence et al., 1999). These methods are described briefly below, and more thoroughly in the Injury Cost Model documentation (Miller, Lawrence, et al., 1998).

First, we estimated the incidence of injury in motor vehicle crashes on public roads. The estimated number of medically treated victim by diagnosis, age group, and sex for patients not admitted to hospital came from 1996 National Health Interview Survey which explicitly identifies crash victims. For hospital-admitted victims, following Miller, Romano and Spicer, we created a version of the 1996 National Hospital Discharge Survey (NHDS) with injury causes inferred for the 37 percent of injury victims with no cause reported in the data set. NHDS provides seven fields for coding injury diagnoses and/or causes. The cause distribution of known cases with five or fewer diagnoses by primary diagnosis, age group, sex, and number of diagnoses (1–2, 3–5) was inferred probabilistically, based on the causes that were reported. For cases with 6 or 7 diagnoses, we inferred the cause distribution using data on discharges with at least 6 diagnoses from 6 States—California, Maryland, Missouri, New York, South Carolina, and Vermont—with mandatory cause coding and either a separate cause-code field or at least 10 diagnosis/cause fields.

Next, we computed medical costs for each crash victim. Although the methods differed for deaths, injury survivors admitted to the hospital, and injury survivors treated elsewhere, in each case, we extracted costs of initial treatment from nationally representative or multi-State data sets. By diagnosis, we then added emergency medical, medical follow-up, rehabilitation, and long-term costs computed from national data on ancillary costs and the percentage of medical costs associated with initial treatment. Due to data unavailability, the emergency medical, follow-up, rehabilitation and long-term costs were less current than the costs for initial treatment. More specifically, for non-hospitalized victims, medical costs were estimated from:

- Medical care costs per visit by diagnosis from 1992–1994 Civilian Health and Medical Program of the Uniformed Services (CHAMPUS) data.
- Visits per case during an average of six months post-injury and emergency transport, prescription and ancillary payments per case by diagnosis group from 1987 National Medical Expenditure Survey (NMES) data.
- The percentage of medical costs for non-admitted patients that are incurred more than six months after injury by diagnosis from 1979–1988 Detailed Claims Information (DCI) data of the National Council on Compensation Insurance (Miller et al., 1991, used the same DCI data, which are unique).

For admitted patients, medical costs were estimated from

- Actual hospital days per patient from the NHDS file.
- Costs per day of hospital stay by diagnosis, age group, and sex estimated from 1994 New York and 1994–1995 Maryland hospital discharge data, price-adjusted to national estimates. These two States are the only ones that regulated and tracked the detailed relationships between charges, payments, and actual costs of hospital care in recent years, a practice New York discontinued after 1994. Because healthcare payers negotiate widely varying, sometimes large discounts from providers, the more widely available data on hospital charges bear little relationship to actual hospital costs.
- The ratio of professional fees for inpatient care to hospital payments from 1992–1994 CHAMPUS data.
- The average number of hospital admissions per patient by primary injury diagnosis from 1994 Missouri hospital discharge data (which we used because we were able to obtain a file with linkable patient identifiers).
- Pre-hospital, prescription and ancillary payments per case, as well as short-term post-discharge costs, from 1987 NMES data.
- The percentage of medical costs for admitted patients that are incurred more than 6 months after injury by diagnosis from 1979–1988 DCI data.

Medical costs for crash fatalities were computed from U.S. Vital Statistics data on place of treatment. All fatalities were assigned the difference in present value of burial costs in 1996 versus at the end of the victim's expected life span (from Miller, Pindus, et al., note x), as well as coroner or medical examiner costs from NHTSA (1983). Except for deaths at the scene, we added costs of emergency transport from 1987 NMES data. For deaths on arrival or in the

emergency department, we added average charges for fatalities in the emergency department by external cause grouping from 1997 South Carolina emergency department discharge data, adjusted to US prices. Deaths in hospital were costed using the same methods as other hospital admissions but with no post-discharge costs. We assumed deaths in nursing home were preceded by hospital admissions of average cost and involved a 30-day skilled nursing facility stay at double the cost of an intermediate care facility (from Bureau of the Census, 1998).

Unfortunately, within the budget available, the aggregate cost estimate for nonfatal cases could not be broken down by MAIS and body region. Therefore, we adjusted published prior medical cost estimates for 1996 highway crashes (Miller, Lestina, & Spicer, 1998) to account for the difference between our total nonfatal medical cost estimate and the published one, essentially retaining the prior cost patterns by severity. The adjusting factor was 0.924. The difference between our estimate and the previous estimate can be explained by the fact that Miller, Lestina and Spicer inflated medical cost estimates using the medical spending inflator, whereas our estimate directly reflects the medical spending levels of the managed care era. Obviously, the use of the above adjusting factor does not guarantee that the adjustment of medical cost estimates by severity is as accurate as the adjustment of the medical cost estimate as a whole.

Since the new cost estimates preserve the old pattern of costs by MAIS and body region, it is worth summarizing how those costs were computed. Medical payments for paralyzing (MAIS 4 and 5) spinal cord injury came from a household and institutional survey (Berkowitz et al., 1990). Miller et al. (1991) and Miller, Pindus, and Douglass (1993) developed the remaining costs from 1979–1988 DCI data. Payments per case were estimated by diagnosis and hospitalization status (admitted or not). Non-hospitalized costs were built from 1982–1986 NASS data on whether treated and DCI costs per treated case. Hospitalized costs combined NASS length of initial hospital stay, DCI hospital per diem payments, readmission costs in the year after injury from MacKenzie, Shapiro, et al. (1988), and DCI data on longer-term payments. The costs were validated against average costs per injured highway crash survivor by hospitalization status from Rice et al. (1989). The costs were inflated to 1999 dollars using medical spending per capita as an inflator series.

**Emergency Services Costs.**

These include police, fire, ambulance, and helicopter services. Miller et al. (1991) computed emergency transport costs from the cost per transport by hospitalization status in Rice et al. (1989) and NASS data on the percentage of cases transported by treatment level, MAIS, and body region. They allocated helicopter transport proportionally across nonfatal MAIS 4 and 5 injureds and fatalities who died in the hospital. The costs per transport came from National Medical Care Utilization and Expenditure Survey data (Rice et al., 1989) and published helicopter medical transport statistics, and are averages for all injury victims who were transported. From a survey of six providers, Miller et al. estimated 65 percent of trauma transports were for motor vehicle crashes.

Fire and police costs were computed from assumed response patterns by crash severity and vehicle involvement, constrained by data on total responses. For fatal, injury, and property damage only (PDO) crashes, time spent per police cruiser responding came from 10 jurisdictions with automated police time-tracking systems. A single officer was assumed to have responded to

a PDO crash and one officer per injury to other crashes. Time spent per fire truck responding came from nine large fire departments. It was assumed that the fire personnel would respond to:

- 90 percent of fatal and severe injury crashes and 95 percent of critical injury crashes.
- 35 percent of serious injury crashes and 15 percent of moderate injury crashes.
- 40 percent of heavy truck crashes involving minor injury and 1 percent of other minor injury crashes.
- 25 percent of police-reported heavy truck crashes involving only property damage.

**Property Damage.**

This is the cost to repair or replace damaged vehicles, cargo, and other property including the costs of damage compensation. Property damage costs were inflated, using the Consumer Price Index–All Items, from Miller et al. (1991) for medium/heavy vehicles and from Blincoe (1996) for light vehicles. The original medium/heavy vehicle property damage estimates came from Bureau of Motor Carrier Safety (BMCS) 50-B and 50-T crash reports and represent vehicles in interstate commerce. The BMCS reports were completed by vehicle owners. BMCS did not audit owner estimates of crash damages for accuracy.

**Lost Productivity.**

This includes wages, fringe benefits, and household work lost by the injured, as well as the costs of processing productivity loss compensation claims. It also includes productivity loss by those stuck in crash-related traffic jams and by co-workers and supervisors investigating crashes, recruiting and training replacements for disabled workers, and repairing damaged company vehicles. Excluded are earnings lost by family and friends caring for the injured and the value of schoolwork lost. The productivity loss resulting from traffic delay is given separately and as part of total productivity lost.

Miller (1997) updated the lifetime earnings and household production loss models in Miller et al. (1991) with 1990–1991 data. Loss models estimate likely lifetime productivity based on demographic characteristics, earnings profiles, and life tables. The productivity loss attached to each NASS/CDS victim was age and sex specific. For cost calculations by crash type, tailoring costs for each case by age and sex represents a major improvement over Miller et al. Employer productivity losses largely were recomputed using the assumptions in Miller, Galbraith, et al. (1995), namely:

- A quarter of the time wasted by deaths, disabling injuries, and injuries outside of work is supervisory time.
- A fatal injury costs 4 months of productivity (wages plus fringe benefits). Recruitment, retraining, and lost special skills are the major cost factors.
- A disabling injury serious enough to qualify for Worker's Compensation or require hospital admission costs 1 month of productivity for other employees. On average, such injuries involve 41 days of work loss.
- Other injuries outside of work cause 3 days of lost productivity if they involve work loss and 1.5 days otherwise.

- Other injuries on the job that cause work loss cost 2 days of supervisory time and 4 days of non-supervisory time.
- Work-related crashes without lost-work injuries cost 2 days of supervisory time and 1 day of non-supervisory time. This assumption is consistent with PHH FleetAmerica's unpublished data from their subscribers.
- Other on-duty injuries without work loss cost 1 supervisory day and 1 non-supervisory day.

Following Miller et al. (1999), however, supervisor and co-worker staff time lost to a permanently disabling injury was assumed to equal the losses for a fatality.

These assumptions yield employer costs that average $13,379 for a fatality, $2,162 for a lost-workday injury, and $405 for an injury without work loss. By comparison, in a Washington State study of construction injury costs, Hinze (1991) finds employer costs of $1,273 for a lost-workday or restricted-activity injury and $462 for an injury without workdays lost. Leigh et al. (1995) estimate employer costs at $8,108 for a fatality, $6,757 for a partial permanent disability, $676 for a less serious lost-workday injury, and $135 for an injury without work loss (note, costs inflated to 1999 dollars using the wage index).

Miller (1997) developed the insurance administrative and legal expense models used in the cost computations. It introduced a $100,000 average policy limit on liability claims and a $500,000 limit on average court awards for catastrophic injuries. Legal costs were reestimated with unit litigation costs from Kakalik and Pace (1986) and probabilities of lawsuit from Hensler et al. (1991), as well as the updated medical care and productivity loss estimates used to estimate attorney fees, which average 31 percent of losses recovered (Hensler et al.).

Travel delay was computed similarly to Miller et al. (1991), but with three refinements. First, the prior work differentiated delay by crash severity in proportion to police time at the crash scene. We modified the prior analysis by assuming that the larger number of emergency vehicles involved in injury and fatal crashes creates twice as much delay per minute on the scene as a PDO crash. That assumption, which reduced delay costs for PDO crashes, resulted in an hours-of-delay ratio of 40:130:385 for the delays due to PDO, injury, and fatal crashes, respectively. Second, we increased the hours of delay per urban interstate crash in proportion to the major increase documented by Lan and Hu (2000) in Minneapolis-St Paul. Their study found an average of 5,057 hours of delay per heavy truck crash in Minneapolis-St Paul (and 2,405 hours per crash without heavy vehicles involved). The study collected data on 289 heavy truck crashes (and 3,762 other crashes). Third, the previous analysis arbitrarily assumed no travel delay on some classes of roadways and arbitrarily stepped down the delay estimates for other classes. Instead, we started from the hours of delay per crash on urban interstates (the most complete and data-driven estimates available). Delay for other roadway classes by rural-urban location was computed in proportion to traffic density (vehicle-miles per lane mile) for each roadway class relative to urban interstate. Traffic density was computed from Federal statistical data (Federal Highway Administration, 1998). We used the costs per hour of delay from the prior analysis (60 percent of the wage rate for non-commercial drivers and 100 percent for commercial drivers) since they fell in the range prescribed by current guidance from the Office of the Secretary (U.S.

Department of Transportation, 1997). Table 1 details the delay estimates per heavy vehicle crash by roadway class and location.

**Table 1. Hours of Delay per Heavy Vehicle Crash by Roadway Class, Location, and Severity**

| Road Class/Location | PDO | Injury | Fatal |
|---|---|---|---|
| Interstate/Urban | 2,260 | 7,344 | 21,749 |
| Other Freeway/Urban | 1,766 | 5,737 | 16,990 |
| Major Arterial/Urban | 949 | 3,082 | 9,127 |
| Minor Arterial/Urban | 594 | 1,929 | 5,711 |
| Collector/Urban | 31 | 102 | 301 |
| Local Street/Urban | 9 | 28 | 83 |
| Interstate/Rural | 814 | 2,646 | 7,835 |
| Major Arterial/Rural | 416 | 1,350 | 3,999 |
| Minor Arterial/Rural | 255 | 829 | 2,454 |
| Major Collector/Rural | 10 | 34 | 100 |
| Minor Collector/Rural | 4 | 14 | 42 |
| Local Street/Rural | 1 | 4 | 12 |

Note: Delay on local streets includes vehicles unable to exit from driveways as planned and therefore not in operation. Each hour of delay is valued at $13.86 in urban areas and $16.49 in rural areas. The cost differential is due to the differences in vehicle occupancy.

**Monetized Quality-Adjusted Life Years.**

This values the pain, suffering, and quality of life that the family looses because of a death or injury. For fatalities, the monetized value of QALY loss ($2.7 million) comes from the Office of the Secretary of Transportation's (OST) guidance (Krusei & McFadden, 1996). It is computed from the amount people routinely spend (in dollars or time) to reduce their risk of death and injury. The value derives from almost 50 studies of explicit or implicit family expenditures on auto safety features, pedestrian safety, and smoke detectors, and of extra wages paid to workers who take risky jobs. The OST value given is for the average highway crash fatality. We used it to compute the present value of QALY loss per fatality by victim age and sex, then applied those values to the age and sex distribution of people killed in medium/heavy vehicle crashes in 1997 from FARS.

For nonfatal injuries, as in the OST's guidance (Krusei & McFadden, 1996), the costs are developed from estimated QALYs lost. A QALY is a health outcome measure that assigns a value of 1 to a year of perfect health and 0 to death. Prior studies (Miller 1993; Miller, Pindus, et al., 1995) assessed QALY losses along seven dimensions: cognitive, mobility, bending/grasping/lifting, sensory, cosmetic, pain, and ability to work. With survey data describing how people value losses within and between dimensions, they computed average

QALY loss for crash victims by MAIS and body region. To compute the percentage of lifetime QALYs lost over the victim's lifetime, one averages the fraction of perfect health lost (the QALY loss) during each year that a victim is recovering from a health problem or living with a residual disability (with some adjustments to get a present value estimate). To monetize the loss, we multiplied the percentage loss by the loss per fatality when someone of the victim's age and sex was killed. To avoid double-counting, we subtracted lost productivity from estimated quality of life lost.

The resulting cost estimates were inflated to 1999 dollars using the Employment Cost Index (Council of Economic Advisors, 2000). Finally, costs per injury were multiplied by the average number of injuries by severity per crash to produce cost estimates per crash, by truck type, and crash severity.

# RESULTS

Table 2 summarizes estimated victims per highway crash, by truck/bus type and police-reported injury severity. For example, the table indicates that crashes in which trucks with no trailers are involved, an average of 1.993 people had no injury, 0.198 had possible injury, and so on. An average of 2.430 are involved in these types of crashes. Some caution is warranted in interpreting these numbers because police-reported injury severity is often inaccurate. Many victims who the police code as not injured are actually injured; conversely, the majority of injuries reported by police as disabling do not result in hospital admission (Miller et al. 1991). These shortcomings are one of the reasons why Miller, Lestina, and Spicer (1998) developed their injury costs based on the body region injured, MAIS threat-to-life severity, and level of medical treatment.

Another problem with police-reported counts of people in crashes, which is evident in Table 2, is the undercount of uninjured people involved in transit/intercity bus crashes. Specifically, Table 2 suggests that no more than three people were involved in an average transit/intercity bus crash. This obviously incorrect number results from the widespread police practice of not recording uninjured bus passengers involved in a crash.

Table 3 presents estimated victims per highway crash, by truck/bus type, crash severity, and police-reported injury severity. As mentioned earlier, estimates for fatal crashes came from FARS. Truck-tractors with two or three trailers involved in a fatal crash caused more deaths than any other truck configuration—an average of 1.118 people had fatal injuries in a typical crash. The unweighted and weighted GES counts of people involved in truck/bus crashes by vehicle type and police-reported severity are presented in Tables 4 through 7. The number of people killed in fatal truck/bus crashes is presented in Table 8. The GES tables reveal adequate cell sizes (a minimum of 10 and preferably 30 cases per cell) except when trailer information is unknown. Given the cell sizes, when information about trailers is unknown, it is advisable to use the average cost per large truck crash rather than a configuration-specific cost.

Table 9 presents the average estimated costs per victim injured by vehicle type and injury severity. These costs vary modestly with vehicle type. Their estimation was an intermediate step toward estimating costs per crash. Table 10 provides detailed cost per crash estimates for different truck/bus configurations and crash severity.

Table 11 presents the estimated costs per crash for all crashes, and Table 12 presents the estimated costs per crash for injury crashes only. The $117,309 average cost per crash for vehicles with two or three trailers far exceeds the $84,587 for a tractor-trailer crash. Bus crashes and crashes where trailer presence was unknown have the lowest average costs.

Crashes involving bobtails have higher average costs than straight truck crashes. The reason for the finding is unclear. These vehicles could have stability problems. Alternatively, since their engines are far more powerful than their trailer-less weight demands, they may be driven aggressively. Also, since bobtail drivers are not generating revenue and are often not paid, they may face financial incentives to speed. We also conducted a sensitivity analysis, using the travel delay costs from Miller et al. (1991) instead of the new estimates. The resulting crash costs are presented Tables 14–18 in the appendix. On a percentage basis, costs for low-severity crashes are much more sensitive to this change than costs for severe crashes.

Table 13 shows the total cost of police-reported heavy vehicle crashes captured in 1997 GES data. The costs of large truck crashes in 1997 exceeded $24 billion. That total included $8.7 billion in productivity losses, $2.5 billion in resource costs, and quality of life losses valued at $13.1 billion. The largest share of this total was the $13.2 billion in costs of single-trailer combination trucks. Bobtail crashes cost about one thirty-seventh this much, meaning that bobtails would be over- (or under-) represented in crashes if they comprise less (or more) than about 2.7 percent of combination truck traffic. Similarly, combination trucks with multiple trailers accounted for about 7.6 percent of combination truck crash costs. Single straight trucks accounted for $8.2 billion dollars of the truck crash costs, about one third. Bus crashes were a much smaller factor than truck crashes, costing less than $1 billion in 1997.

Computed with 1997 Vehicle Inventory and Use Survey data on truck mileage (Bureau of the Census, 1999), the crash costs per 1,000 truck miles are $259 for single unit trucks, $138 for single combination trucks, and $134 for multiple combinations.

**Table 2. The Average Number of People Involved in a Truck/Bus Crash by Truck/Bus Type and Police-Reported Injury Severity (1988–1997)**

| Truck/Bus Crash Type | No Injury | Possible Injury | Non-Incapaci-tating | Incapaci-tating | Fatal Injury | Unknown Severity | Unknown if Injured |
|---|---|---|---|---|---|---|---|
| Straight truck, no trailer | 1.993 | 0.198 | 0.108 | 0.059 | 0.008 | 0.005 | 0.059 |
| Straight truck with trailer | 2.004 | 0.138 | 0.096 | 0.054 | 0.010 | 0.002 | 0.095 |
| Straight truck, unknown if with trailer | 1.547 | 0.018 | 0.041 | 0.017 | | | 0.765 |
| Bobtail | 1.966 | 0.163 | 0.110 | 0.060 | 0.010 | 0.003 | 0.054 |
| Truck-tractor, 1 trailer | 1.836 | 0.156 | 0.099 | 0.067 | 0.015 | 0.003 | 0.073 |
| Truck-tractor, 2 or 3 trailers | 1.656 | 0.180 | 0.121 | 0.058 | 0.027 | 0.002 | 0.079 |
| Truck-tractor, with unknown # of trailers | 1.936 | 0.058 | 0.012 | 0.043 | 0.012 | | 0.233 |
| Medium/heavy truck, unknown if with trailer | 1.611 | 0.161 | 0.058 | 0.041 | 0.002 | 0.003 | 0.307 |
| All large trucks | 1.903 | 0.171 | 0.102 | 0.062 | 0.012 | 0.004 | 0.072 |
| Bus, transit/intercity | 2.253 | 0.380 | 0.101 | 0.049 | 0.003 | 0.023 | 0.120 |

Source: GES

**Table 3a. The Average Number of People Involved in a Truck/Bus Crash by Truck/Bus Type, Crash Severity, and Police-Reported Injury Severity (1988–1997), where Maximum Severity in Crash: No Injury.**

| Truck/Bus Type | No Injury |
|---|---|
| Straight truck, no trailer | 2.310 |
| Straight truck with trailer | 2.277 |
| Straight truck, unknown if with trailer | 2.003 |
| Bobtail | 2.238 |
| Truck-tractor, 1 trailer | 2.123 |
| Truck-tractor, 2 or 3 trailers | 1.895 |
| Truck-tractor, with unknown # of trailers | 2.323 |
| Medium/heavy truck, unknown if with trailer | 1.956 |
| All large trucks | 2.202 |
| Bus, transit/intercity | 2.543 |

Source: GES and FARS

**Table 3b. The Average Number of People Involved in a Truck/Bus Crash by Truck/Bus Type, Crash Severity, and Police-Reported Injury Severity (1988–1997), where Maximum Severity in Crash: Possible Injury.**

| Truck/Bus Type | No Injury | Possible Injury | Unknown Severity | Unknown if Injured |
|---|---|---|---|---|
| Straight truck, no trailer | 1.529 | 1.309 | 0.002 | 0.025 |
| Straight truck with trailer | 1.558 | 1.208 | – | 0.059 |
| Straight truck, unknown if with trailer | 1.153 | 1.005 | – | 0.382 |
| Bobtail | 1.483 | 1.218 | – | 0.033 |
| Truck-tractor, 1 trailer | 1.371 | 1.242 | 0.002 | 0.045 |
| Truck-tractor, 2 or 3 trailers | 1.400 | 1.225 | – | 0.071 |
| Truck-tractor, with unknown # of trailers | 0.720 | 1.053 | – | 0.132 |
| Medium/heavy truck, unknown if with trailer | 1.123 | 1.476 | – | 0.236 |
| All large trucks | 1.445 | 1.270 | 0.002 | 0.039 |
| Bus, transit/intercity | 1.683 | 1.765 | 0.005 | 0.081 |

Source: GES and FARS

**Table 3c. The Average Number of People Involved in a Truck/Bus Crash by Truck/Bus Type, Crash Severity, and Police-Reported Injury Severity (1988–1997), where Maximum Severity in Crash: Non-Incapacitating Injury.**

| Truck/Bus Type | No Injury | Possible Injury | Non-Incapacitating | Unknown Severity | Unknown if Injured |
|---|---|---|---|---|---|
| Straight truck, no trailer | 1.154 | 0.275 | 1.194 | 0.002 | 0.033 |
| Straight truck with trailer | 1.209 | 0.144 | 1.137 | 0.002 | 0.061 |
| Straight truck, unknown if with trailer | 1.320 | 0.122 | 1.213 | 0.000 | 0.478 |
| Bobtail | 1.320 | 0.266 | 1.302 | – | 0.029 |
| Truck-tractor, 1 trailer | 1.110 | 0.198 | 1.143 | 0.003 | 0.034 |
| Truck-tractor, 2 or 3 trailers | 1.262 | 0.255 | 1.176 | 0.001 | 0.011 |
| Truck-tractor, with unknown # of trailers | 1.272 | 0.411 | 1.074 | – | 0.208 |
| Medium/heavy truck, unknown if with trailer | 1.180 | 0.164 | 1.237 | –- | 0.101 |
| All large trucks | 1.145 | 0.230 | 1.172 | 0.002 | 0.035 |
| Bus, transit/intercity | 1.853 | 0.779 | 1.345 | 0.048 | 0.132 |

Source: GES and FARS

**Table 3d. The Average Number of People Involved in a Truck/Bus Crash by Truck/Bus Type, Crash Severity, and Police-Reported Injury Severity (1988–1997), where Maximum Severity in Crash: Incapacitating Injury.**

| Truck/Bus Type | No Injury | Possible Injury | Non-Incapaci-tating | Incapaci-tating | Unknown Severity | Unknown if Injured |
|---|---|---|---|---|---|---|
| Straight truck, no trailer | 1.115 | 0.211 | 0.245 | 1.220 | 0.010 | 0.021 |
| Straight truck with trailer | 1.770 | 0.199 | 0.047 | 1.184 | – | 0.010 |
| Straight truck, unknown if with trailer | 0.290 | 0.225 | 0.225 | 1.003 | – | 0.484 |
| Bobtail | 1.085 | 0.184 | 0.236 | 1.157 | – | 0.021 |
| Truck-tractor, 1 trailer | 1.016 | 0.148 | 0.136 | 1.170 | 0.005 | 0.022 |
| Truck-tractor, 2 or 3 trailers | 1.005 | 0.200 | 0.167 | 1.107 | – | 0.100 |
| Truck-tractor, with unknown # of trailers | 1.819 | – | – | 1.021 | – | – |
| Medium/heavy truck, unknown if with trailer | 0.354 | 0.316 | 0.350 | 1.927 | – | 0.020 |
| All large trucks | 1.076 | 0.175 | 0.179 | 1.190 | 0.006 | 0.022 |
| Bus, transit/intercity | 1.417 | 0.938 | 0.260 | 1.361 | 0.071 | 0.036 |

Source: GES and FARS

**Table 3e. The Average Number of People Involved in a Truck/Bus Crash by Truck/Bus Type, Crash Severity, and Police-Reported Injury Severity (1988–1997), where Maximum Severity in Crash: Fatal Injury.**

| Truck/Bus Type | No Injury | Possible Injury | Non-Incapaci-tating | Incapaci-tating | Fatal Injury | Unknown Severity | Unknown if Injured |
|---|---|---|---|---|---|---|---|
| Straight truck, no trailer | 0.828 | 0.236 | 0.28491 | 0.353 | 1.108 | 0.007 | 0.006 |
| Straight truck with trailer | 0.936 | 0.231 | 0.30631 | 0.317 | 1.081 | 0.026 | 0.002 |
| Straight truck, unknown if with trailer | 0.955 | 0.273 | 0.36364 | 0.227 | 1.000 | - | - |
| Bobtail | 0.782 | 0.241 | 0.2455 | 0.326 | 1.112 | 0.008 | 0.008 |
| Truck-tractor, 1 trailer | 0.866 | 0.221 | 0.28035 | 0.337 | 1.109 | 0.007 | 0.009 |
| Truck-tractor, 2 or 3 trailers | 0.855 | 0.237 | 0.3043 | 0.295 | 1.118 | 0.007 | 0.007 |
| Truck-tractor, with unknown # of trailers | 0.961 | 0.353 | 0.17647 | 0.348 | 1.054 | 0.015 | 0.059 |
| Medium/heavy truck, unknown if with trailer | 0.884 | 0.390 | 0.14938 | 0.357 | 1.058 | 0.017 | 0.050 |
| All large trucks | 0.856 | 0.227 | 0.279 | 0.337 | 1.108 | 0.078 | 0.087 |
| Bus, transit/intercity | 0.872 | 1.175 | 0.795 | 0.477 | 1.110 | 0.106 | 0.013 |

Source: GES and FARS

**Table 3f. The Average Number of People Involved in a Truck/Bus Crash by Truck/Bus Type, Crash Severity, and Police-Reported Injury Severity (1988–1997), where Maximum Severity in Crash: Unknown.**

| Truck/Bus Type | No Injury | Unknown Severity | Unknown if Injured |
|---|---|---|---|
| Straight truck, no trailer | 1.334 | 1.265 | 0.099 |
| Straight truck with trailer | 3.390 | 1.061 | 0.049 |
| Straight truck, unknown if with trailer | – | – | – |
| Bobtail | 0.966 | 1.030 | - |
| Truck-tractor, 1 trailer | 0.875 | 1.137 | 0.042 |
| Truck-tractor, 2 or 3 trailers | 0.052 | 1.000 | – |
| Truck-tractor, with unknown # of trailers | – | – | – |
| Medium/heavy truck, unknown if with trailer | 3.370 | 2.780 | 0.593 |
| All large trucks | 1.149 | 1.198 | 0.069 |
| Bus, transit/intercity | 1.716 | 3.216 | 0.063 |

Source: GES and FARS

**Table 3g. The Average Number of People Involved in a Truck/Bus Crash by Truck/Bus Type, Crash Severity, and Police-Reported Injury Severity (1988–1997), where Maximum Severity in Crash: Unknown if Injured.**

| Truck/Bus Type | No Injury | Unknown if Injured |
|---|---|---|
| Straight truck, no trailer | 1.137 | 1.075 |
| Straight truck with trailer | 1.139 | 1.081 |
| Straight truck, unknown if with trailer | 0.105 | 3.686 |
| Bobtail | 1.220 | 1.033 |
| Truck-tractor, 1 trailer | 1.326 | 1.028 |
| Truck-tractor, 2 or 3 trailers | 1.129 | 1.013 |
| Truck-tractor, with unknown # of trailers | 1.209 | 1.003 |
| Medium/heavy truck, unknown if with trailer | 1.202 | 1.082 |
| All large trucks | 1.241 | 1.051 |
| Bus, transit/intercity | 1.710 | 1.158 |

Source: GES and FARS

**Table 4. The Unweighted Count of Truck Occupants Involved in Crashes by Truck/Bus Type and Police-Reported Injury Severity (1988–1997).**

| Truck/Bus Type | No Injury | Possible Injury | Non-Incapaci-tating | Incapaci-tating | Fatal Injury | Unknown Severity | Unknown if Injured |
|---|---|---|---|---|---|---|---|
| Straight truck, no trailer | 21,139 | 2,139 | 1,278 | 602 | 43 | 47 | 546 |
| Straight truck, with trailer | 2,373 | 177 | 104 | 84 | 7 | 3 | 83 |
| Straight truck, unknown if with trailer | 21 | 1 | 2 | 0 | 0 | 0 | 12 |
| Bobtail | 2,545 | 190 | 157 | 76 | 12 | 4 | 73 |
| Truck-tractor, 1 trailer | 37,288 | 2,488 | 1,705 | 841 | 111 | 57 | 1,478 |
| Truck-tractor, 2 or 3 trailers | 1,267 | 97 | 51 | 27 | 3 | 1 | 31 |
| Truck-tractor, with unknown # of trailers | 118 | 4 | 3 | 4 | 1 | 0 | 30 |
| Medium/heavy truck, unknown if with trailer | 483 | 47 | 8 | 10 | 1 | 0 | 127 |
| All large trucks | 65,234 | 5,143 | 3,308 | 1,644 | 178 | 112 | 2,380 |
| Bus, transit/intercity | 2,535 | 1,175 | 242 | 141 | 3 | 126 | 157 |

Source: GES

**Table 5. The Unweighted Count of Non Truck Occupants Involved in Crashes by Truck/Bus Type and Police-Reported Injury Severity (1988–1997).**

| Truck/Bus Type | No Injury | Possible Injury | Non-Incapaci-tating | Incapaci-tating | Fatal Injury | Unknown Severity | Unknown if Injured |
|---|---|---|---|---|---|---|---|
| Straight truck, no trailer | 14,964 | 5,807 | 3,535 | 2,076 | 295 | 162 | 483 |
| Straight truck, with trailer | 1,686 | 603 | 370 | 212 | 31 | 6 | 68 |
| Straight truck, unknown if with trailer | 21 | 4 | 8 | 3 | 0 | 0 | 4 |
| Bobtail | 2,058 | 696 | 477 | 249 | 32 | 7 | 63 |
| Truck-tractor, 1 trailer | 27,914 | 10,810 | 6,536 | 3,892 | 686 | 198 | 1,089 |
| Truck-tractor, 2 or 3 trailers | 939 | 384 | 244 | 128 | 29 | 2 | 45 |
| Truck-tractor, with unknown # of trailers | 140 | 27 | 14 | 7 | 1 | 0 | 5 |
| Medium/heavy truck, unknown if with trailer | 453 | 169 | 99 | 40 | 4 | 7 | 18 |
| All large trucks | 48,175 | 18,500 | 11,283 | 6,607 | 1,078 | 382 | 1,775 |
| Bus, transit/intercity | 1,796 | 522 | 414 | 207 | 19 | 14 | 89 |

Source: GES

**Table 6. The Weighted Count of Truck Occupants Involved in Crashes by Truck/Bus Type and Police-Reported Injury Severity (1988–1997).**

| Truck/Bus Type | No Injury | Possible Injury | Non-Incapaci-tating | Incapaci-tating | Fatal Injury | Unknown Severity | Unknown if Injured |
|---|---|---|---|---|---|---|---|
| Straight truck, no trailer | 1,403,201 | 67,258 | 40,221 | 19,223 | 1,764 | 2,007 | 46,936 |
| Straight truck, with trailer | 134,164 | 3,307 | 2,912 | 2,265 | 99 | 18 | 8,865 |
| Straight truck, unknown if with trailer | 1,352 | 6 | 16 | 0 | 0 | 0 | 364 |
| Bobtail | 204,519 | 6,637 | 5,558 | 2,531 | 471 | 53 | 7,233 |
| Truck-tractor, 1 trailer | 1,657,786 | 56,991 | 45,830 | 25,364 | 3,003 | 1,753 | 86,786 |
| Truck-tractor, 2 or 3 trailers | 43,308 | 2,394 | 1,065 | 440 | 155 | 89 | 2,327 |
| Truck-tractor, with unknown # of trailers | 11,299 | 309 | 16 | 255 | 93 | 0 | 1,970 |
| Medium/heavy truck, unknown if with trailer | 34,399 | 1,786 | 150 | 989 | 55 | 0 | 14,120 |
| All large trucks | 3,490,028 | 138,688 | 95,768 | 51,067 | 5,640 | 3,921 | 168,600 |
| Bus, transit/intercity | 299,571 | 58,285 | 9,692 | 4,050 | 298 | 4,740 | 13,588 |

Source: GES

**Table 7. The Unweighted Count of Non Truck Occupants Involved in Crashes by Truck/Bus Type and Police-Reported Injury Severity (1988–1997).**

| Truck/Bus Type | No Injury | Possible Injury | Non-Incapaci-tating | Incapaci-tating | Fatal Injury | Unknown Severity | Unknown if Injured |
|---|---|---|---|---|---|---|---|
| Straight truck, no trailer | 1,153,704 | 186,354 | 98,000 | 56,327 | 8,086 | 4,968 | 29,100 |
| Straight truck, with trailer | 113,112 | 13,713 | 8,878 | 4,425 | 1,182 | 176 | 2,823 |
| Straight truck, unknown if with trailer | 1,308 | 24 | 54 | 30 | 0 | 0 | 952 |
| Bobtail | 182,888 | 25,525 | 16,023 | 9,374 | 1,541 | 564 | 3,495 |
| Truck-tractor, 1 trailer | 1,458,873 | 207,263 | 121,684 | 88,107 | 22,428 | 4,136 | 36,862 |
| Truck-tractor, 2 or 3 trailers | 34,826 | 6,119 | 4,635 | 2,317 | 1,118 | 11 | 1,412 |
| Truck-tractor, with unknown # of trailers | 12,101 | 393 | 133 | 260 | 46 | 0 | 843 |
| Medium/heavy truck, unknown if with trailer | 42,615 | 5,928 | 2,609 | 990 | 31 | 140 | 552 |
| All large trucks | 2,999,427 | 445,319 | 252,017 | 161,830 | 34,432 | 9,994 | 76,039 |
| Bus, transit/intercity | 244,674 | 33,599 | 14,783 | 7,793 | 526 | 882 | 15,387 |

Source: GES

**Table 8. The Number of People Killed in Truck/Bus Crashes by Truck/Bus Type (1988–1997).**

| Truck/Bus Type | Number of Fatal Crashes | Truck Occupants Killed in Crashes | Non-Truck Occupants Killed in Crashes | Total Number of People Killed in Crashes |
|---|---|---|---|---|
| Straight truck, no trailer | 7,427 | 1,105 | 7,122 | 8,227 |
| Straight truck with trailer | 1,000 | 141 | 940 | 1,081 |
| Straight truck, unknown if with trailer | 22 | 4 | 18 | 22 |
| Bobtail | 2,664 | 455 | 2,507 | 2,962 |
| Truck-tractor, 1 trailer | 28,756 | 4,181 | 27,706 | 31,887 |
| Truck-tractor, 2 or 3 trailers | 1,745 | 286 | 1,665 | 1,951 |
| Truck-tractor, with unknown # of trailers | 204 | 22 | 193 | 215 |
| Medium/heavy truck, unknown if with trailer | 241 | 28 | 227 | 255 |
| All large trucks | 42,059 | 6,221 | 40,378 | 46,599 |
| Bus, transit/intercity | 1,348 | 80 | 1,416 | 1,496 |

Source: FARS

**Table 9. Costs per Victim Injured by Truck/Bus Type and Police-Reported Injury Severity (in 1999 dollars).**

| Truck/Bus Type Involved in Crash | Injury Severity | Medical Costs | Emergency Services | Property Damage | Lost Productivity from Delays | Total Lost Productivity | Monetized QALYs | Total |
|---|---|---|---|---|---|---|---|---|
| Straight truck, no trailer | No injury | 73 | 33 | 1,276 | 3,152 | 3,430 | 262 | 5,074 |
| | Possible injury | 1,144 | 103 | 2,469 | 13,803 | 16,376 | 5,802 | 25,895 |
| | Non-incapacitating injury | 4,027 | 223 | 3,808 | 13,803 | 24,511 | 28,956 | 61,525 |
| | Incapacitating injury | 35,810 | 404 | 4,972 | 13,803 | 58,688 | 242,344 | 342,217 |
| | Fatal Injury | 16,843 | 1,355 | 12,123 | 25,751 | 775,733 | 2,002,242 | 2,808,296 |
| | Injury, severity unknown | 1,725 | 128 | 2,882 | 13,803 | 17,021 | 8,466 | 30,222 |
| | Unknown if injured | 1,466 | 90 | 1,983 | 0 | 3,827 | 8,382 | 15,748 |
| Straight truck with trailer | No injury | 93 | 32 | 1,258 | 3,152 | 3,455 | 388 | 5,227 |
| | Possible injury | 2,886 | 172 | 3,386 | 13,803 | 20,325 | 15,581 | 42,350 |
| | Non-incapacitating injury | 5,132 | 232 | 3,967 | 13,803 | 27,079 | 41,619 | 78,029 |
| | Incapacitating injury | 15,660 | 374 | 4,834 | 13,803 | 43,668 | 146,239 | 210,777 |
| | Fatal Injury | 17,176 | 1,355 | 12,123 | 25,751 | 873,351 | 2,247,819 | 3,151,825 |
| | Injury, severity unknown | 11,339 | 215 | 3,522 | 13,803 | 33,418 | 83,487 | 131,981 |
| | Unknown if injured | 1,018 | 71 | 1,814 | 0 | 2,177 | 6,128 | 11,209 |
| Straight truck, unknown if with trailer | No injury | 73 | 30 | 1,218 | 3,152 | 3,410 | 305 | 5,035 |
| | Possible injury | 3,044 | 174 | 3,376 | 13,803 | 21,268 | 15,717 | 43,579 |
| | Non-incapacitating injury | 4,835 | 229 | 3,977 | 13,803 | 27,326 | 41,632 | 77,998 |
| | Incapacitating injury | 18,263 | 393 | 4,975 | 13,803 | 56,685 | 187,669 | 267,986 |
| | Fatal Injury | 22,642 | 1,355 | 12,123 | 25,751 | 855,695 | 2,038,329 | 2,930,144 |
| | Unknown if injured | 1,003 | 67 | 1,755 | 0 | 2,081 | 6,580 | 11,486 |
| Bobtail | No injury | 71 | 32 | 1,264 | 3,152 | 3,421 | 253 | 5,041 |
| | Possible injury | 1,106 | 102 | 2,442 | 13,803 | 16,320 | 5,615 | 25,585 |
| | Non-incapacitating injury | 3,967 | 223 | 3,804 | 13,803 | 24,709 | 29,050 | 61,753 |
| | Incapacitating injury | 38,480 | 405 | 4,985 | 13,803 | 62,934 | 269,782 | 376,586 |
| | Fatal Injury | 16,936 | 1,336 | 11,954 | 25,390 | 861,124 | 2,216,350 | 3,107,700 |
| | Injury, severity unknown | 1,657 | 126 | 2,836 | 13,803 | 17,014 | 8,710 | 30,344 |
| | Unknown if injured | 1,468 | 91 | 1,998 | 0 | 3,953 | 8,464 | 15,974 |

| Truck/Bus Type Involved in Crash | Injury Severity | Medical Costs | Emergency Services | Property Damage | Lost Productivity from Delays | Total Lost Productivity | Monetized QALYs | Total |
|---|---|---|---|---|---|---|---|---|
| Truck-tractor, 1 trailer | No injury | 91 | 32 | 1,255 | 3,152 | 3,451 | 376 | 5,205 |
| | Possible injury | 2,906 | 172 | 3,380 | 13,803 | 20,495 | 15,803 | 42,757 |
| | Non-incapacitating injury | 5,285 | 234 | 3,975 | 13,803 | 27,189 | 41,834 | 78,517 |
| | Incapacitating injury | 15,467 | 370 | 4,803 | 13,803 | 43,051 | 142,888 | 206,578 |
| | Fatal Injury | 16,876 | 1,355 | 12,123 | 25,751 | 875,662 | 2,143,403 | 3,049,419 |
| | Injury, severity unknown | 6,119 | 137 | 2,481 | 13,803 | 25,731 | 46,002 | 80,470 |
| | Unknown if injured | 1,034 | 72 | 1,832 | 0 | 2,259 | 6,285 | 11,483 |
| Truck-tractor, 2 or 3 trailers | No injury | 97 | 33 | 1,267 | 3,152 | 3,463 | 391 | 5,252 |
| | Possible injury | 2,926 | 173 | 3,382 | 13,803 | 20,573 | 15,639 | 42,692 |
| | Non-incapacitating injury | 5,283 | 234 | 3,968 | 13,803 | 27,196 | 42,920 | 79,601 |
| | Incapacitating injury | 15,257 | 370 | 4,805 | 13,803 | 44,044 | 144,337 | 208,813 |
| | Fatal Injury | 16,748 | 1,355 | 12,123 | 25,751 | 833,139 | 2,033,696 | 2,897,062 |
| | Injury, severity unknown | 333 | 35 | 1,277 | 13,803 | 14,499 | 1,645 | 17,789 |
| | Unknown if injured | 1,041 | 74 | 1,861 | 0 | 2,323 | 6,246 | 11,545 |
| Truck-tractor, unknown # of trailers | No injury | 90 | 32 | 1,253 | 3,152 | 3,437 | 364 | 5,176 |
| | Possible injury | 2,967 | 172 | 3,376 | 13,803 | 21,091 | 16,171 | 43,777 |
| | Non-incapacitating injury | 5,478 | 237 | 4,007 | 13,803 | 25,773 | 40,381 | 75,877 |
| | Incapacitating injury | 16,060 | 361 | 4,727 | 13,803 | 45,993 | 130,854 | 197,996 |
| | Fatal Injury | 16,850 | 1,355 | 12,123 | 25,751 | 802,460 | 1,864,977 | 2,697,765 |
| | Unknown if injured | 1,000 | 65 | 1,721 | 0 | 2,022 | 6,460 | 11,268 |
| Medium/heavy truck, unknown if with trailer | No injury | 76 | 30 | 1,225 | 3,152 | 3,414 | 316 | 5,062 |
| | Possible injury | 2,822 | 171 | 3,392 | 13,803 | 20,059 | 15,618 | 42,062 |
| | Non-incapacitating injury | 4,782 | 226 | 3,935 | 13,803 | 25,907 | 37,534 | 72,385 |
| | Incapacitating injury | 14,788 | 365 | 4,774 | 13,803 | 43,224 | 149,144 | 212,296 |
| | Fatal Injury | 17,833 | 1,355 | 12,123 | 25,751 | 580,980 | 1,822,465 | 2,434,756 |
| | Injury, severity unknown | 3,063 | 71 | 1,597 | 13,803 | 20,849 | 22,679 | 48,260 |
| | Unknown if injured | 1,015 | 68 | 1,764 | 0 | 2,144 | 6,486 | 11,477 |

| Truck/Bus Type Involved in Crash | Injury Severity | Medical Costs | Emergency Services | Property Damage | Lost Productivity from Delays | Total Lost Productivity | Monetized QALYs | Total |
|---|---|---|---|---|---|---|---|---|
| All large trucks | No injury | 85 | 32 | 1,262 | 3,152 | 3,443 | 335 | 5,157 |
| | Possible injury | 2,246 | 146 | 3,039 | 13,803 | 18,947 | 12,048 | 36,427 |
| | Non-incapacitating injury | 4,804 | 230 | 3,912 | 13,803 | 26,183 | 37,012 | 72,141 |
| | Incapacitating injury | 22,977 | 382 | 4,866 | 13,803 | 48,960 | 180,352 | 257,537 |
| | Fatal Injury | 16,889 | 1,355 | 12,123 | 25,751 | 846,510 | 2,100,377 | 2,977,254 |
| | Injury, severity unknown | 4,177 | 133 | 2,658 | 13,803 | 21,855 | 29,374 | 58,197 |
| | Unknown if injured | 1,154 | 77 | 1,871 | 0 | 2,694 | 6,879 | 12,675 |
| Bus, transit/intercity | No injury | 14 | 23 | 1,100 | 126 | 223 | 34 | 1,394 |
| | Possible injury | 2,440 | 168 | 3,600 | 219 | 5,613 | 13,818 | 25,639 |
| | Non-incapacitating injury | 5,807 | 251 | 4,108 | 221 | 16,876 | 58,175 | 85,217 |
| | Incapacitating injury | 10,275 | 298 | 4,503 | 231 | 21,495 | 103,396 | 139,968 |
| | Fatal Injury | 22,642 | 1,355 | 12,123 | 569 | 792,728 | 2,074,193 | 2,903,041 |
| | Injury, severity unknown | 1,328 | 161 | 3,603 | 222 | 4,119 | 6,215 | 15,425 |
| | Unknown if injured | 1,113 | 77 | 1,958 | 158 | 2,378 | 6,212 | 11,739 |

**Table 10. Costs per Crash by Truck/Bus Type and Crash Severity (in 1999 dollars).**

| Truck/Bus Type Involved in Crash | Injury Severity | Medical Costs | Emergency Services | Property Damage | Lost Productivity from Delays | Total Lost Productivity | Monetized QALYs | Total |
|---|---|---|---|---|---|---|---|---|
| Straight truck, no trailer | No injury | 160 | 74 | 2,911 | 7,280 | 7,890 | 571 | 11,605 |
| | Possible injury | 1,648 | 189 | 5,255 | 22,911 | 26,801 | 8,122 | 42,015 |
| | Non-incapacitating injury | 5,276 | 338 | 6,808 | 23,945 | 37,890 | 36,904 | 87,216 |
| | Incapacitating injury | 44,643 | 611 | 9,051 | 26,780 | 85,031 | 302,291 | 441,625 |
| | Fatal Injury | 35,371 | 1,772 | 18,087 | 43,292 | 907,658 | 2,352,174 | 3,315,062 |
| | Injury, severity unknown | 2,540 | 213 | 5,457 | 21,670 | 27,009 | 12,982 | 48,202 |
| | Unknown if injured | 1,673 | 133 | 3,541 | 3,584 | 8,027 | 9,271 | 22,645 |
| Straight truck with trailer | No injury | 206 | 73 | 2,855 | 7,177 | 7,854 | 863 | 11,851 |
| | Possible injury | 3,717 | 263 | 6,167 | 21,587 | 30,022 | 19,601 | 59,769 |
| | Non-incapacitating injury | 6,433 | 333 | 6,641 | 21,517 | 38,065 | 50,336 | 101,808 |
| | Incapacitating injury | 19,593 | 548 | 8,858 | 25,318 | 63,482 | 179,748 | 272,229 |
| | Fatal Injury | 25,677 | 1,731 | 17,933 | 42,974 | 908,354 | 2,261,505 | 3,215,199 |
| | Injury, severity unknown | 15,375 | 348 | 7,892 | 25,324 | 51,966 | 113,546 | 189,126 |
| | Unknown if injured | 1,203 | 114 | 3,398 | 3,589 | 6,241 | 6,955 | 17,911 |
| Straight truck, unknown if with trailer | No injury | 146 | 60 | 2,441 | 6,313 | 6,842 | 626 | 10,115 |
| | Possible injury | 2,109 | 154 | 3,891 | 11,006 | 15,663 | 11,120 | 32,937 |
| | Non-incapacitating injury | 6,654 | 364 | 7,589 | 22,588 | 40,643 | 55,252 | 110,501 |
| | Incapacitating injury | 14,282 | 387 | 6,071 | 16,039 | 50,901 | 138,716 | 210,358 |
| | Fatal Injury | 24,118 | 1,542 | 16,236 | 39,510 | 656,642 | 1,709,226 | 2,407,764 |
| | Unknown if injured | 3,741 | 278 | 6,980 | 330 | 8,380 | 23,999 | 43,378 |
| Bobtail | No injury | 155 | 72 | 2,817 | 7,053 | 7,640 | 549 | 11,233 |
| | Possible injury | 1,509 | 176 | 4,930 | 21,493 | 25,123 | 7,376 | 39,113 |
| | Non-incapacitating injury | 5,604 | 364 | 7,362 | 25,807 | 41,183 | 40,039 | 94,552 |
| | Incapacitating injury | 45,630 | 577 | 8,543 | 25,183 | 85,637 | 319,826 | 460,214 |
| | Fatal Injury | 36,033 | 1,761 | 17,849 | 42,411 | 961,899 | 2,420,455 | 3,437,995 |
| | Injury, severity unknown | 1,825 | 162 | 4,150 | 17,255 | 20,802 | 9,335 | 36,274 |
| | Unknown if injured | 1,540 | 127 | 3,513 | 3,846 | 7,891 | 8,728 | 21,799 |

| Truck/Bus Type Involved in Crash | Injury Severity | Medical Costs | Emergency Services | Property Damage | Lost Productivity from Delays | Total Lost Productivity | Monetized QALYs | Total |
|---|---|---|---|---|---|---|---|---|
| Truck-tractor, 1 trailer | No injury | 191 | 68 | 2,660 | 6,691 | 7,319 | 788 | 11,025 |
| | Possible injury | 3,810 | 262 | 6,010 | 21,500 | 30,368 | 20,489 | 60,939 |
| | Non-incapacitating injury | 6,761 | 341 | 6,683 | 22,044 | 39,059 | 51,444 | 104,287 |
| | Incapacitating injury | 19,360 | 525 | 7,992 | 23,343 | 60,848 | 176,511 | 265,237 |
| | Fatal Injury | 26,308 | 1,761 | 18,057 | 42,962 | 956,183 | 2,365,564 | 3,367,873 |
| | Injury, severity unknown | 7,444 | 184 | 3,879 | 18,453 | 32,449 | 54,492 | 98,448 |
| | Unknown if injured | 1,186 | 118 | 3,557 | 4,180 | 6,905 | 6,929 | 18,693 |
| Truck-tractor, 2 or 3 trailers | No injury | 183 | 62 | 2,399 | 5,973 | 6,562 | 735 | 9,940 |
| | Possible injury | 3,796 | 262 | 6,040 | 21,315 | 30,212 | 20,066 | 60,377 |
| | Non-incapacitating injury | 7,083 | 362 | 7,163 | 23,747 | 41,352 | 54,166 | 110,125 |
| | Incapacitating injury | 18,472 | 525 | 8,129 | 23,521 | 61,094 | 171,808 | 260,026 |
| | Fatal Injury | 25,751 | 1,764 | 18,091 | 43,130 | 1,034,892 | 2,462,275 | 3,542,774 |
| | Injury, severity unknown | 504 | 44 | 1,447 | 13,966 | 14,997 | 2,491 | 19,483 |
| | Unknown if injured | 1,108 | 107 | 3,199 | 3,558 | 6,135 | 6,414 | 16,962 |
| Truck-tractor, unknown # of trailers | No injury | 209 | 74 | 2,908 | 7,324 | 7,971 | 817 | 11,979 |
| | Possible injury | 3,172 | 203 | 4,479 | 16,030 | 23,902 | 17,583 | 49,339 |
| | Non-incapacitating injury | 7,421 | 382 | 7,681 | 24,513 | 41,072 | 51,591 | 108,146 |
| | Incapacitating injury | 15,383 | 403 | 6,795 | 18,954 | 52,043 | 131,674 | 206,299 |
| | Fatal Injury | 24,588 | 1,689 | 17,640 | 42,482 | 941,168 | 2,260,946 | 3,246,030 |
| | Unknown if injured | 1,123 | 106 | 3,275 | 3,812 | 6,224 | 6,933 | 17,660 |
| Medium/heavy truck, unknown if with trailer | No injury | 142 | 59 | 2,381 | 6,166 | 6,652 | 574 | 9,807 |
| | Possible injury | 4,506 | 303 | 6,805 | 23,912 | 33,852 | 24,865 | 70,330 |
| | Non-incapacitating injury | 6,541 | 351 | 7,070 | 23,059 | 39,477 | 48,953 | 102,392 |
| | Incapacitating injury | 31,317 | 853 | 12,130 | 36,905 | 101,557 | 313,119 | 458,976 |
| | Fatal Injury | 25,946 | 1,703 | 17,704 | 42,633 | 911,627 | 2,291,273 | 3,248,252 |
| | Injury, severity unknown | 9,424 | 345 | 9,695 | 49,008 | 70,826 | 68,285 | 158,574 |
| | Unknown if injured | 1,197 | 111 | 3,399 | 3,787 | 6,446 | 7,402 | 18,556 |

| Truck/Bus Type Involved in Crash | Injury Severity | Medical Costs | Emergency Services | Property Damage | Lost Productivity from Delays | Total Lost Productivity | Monetized QALYs | Total |
|---|---|---|---|---|---|---|---|---|
| All large trucks | No injury | 182 | 70 | 2,764 | 6,939 | 7,565 | 718 | 11,299 |
| | Possible injury | 3,051 | 237 | 5,778 | 22,114 | 29,228 | 16,124 | 54,419 |
| | Non-incapacitating injury | 6,285 | 344 | 6,813 | 23,000 | 39,084 | 46,694 | 99,220 |
| | Incapacitating injury | 28,685 | 560 | 8,454 | 24,791 | 70,269 | 224,204 | 332,172 |
| | Fatal Injury | 28,429 | 1,757 | 17,975 | 42,987 | 969,247 | 2,401,793 | 3,419,202 |
| | Injury, severity unknown | 5,357 | 199 | 4,669 | 20,156 | 30,392 | 36,814 | 77,431 |
| | Unknown if injured | 1,326 | 121 | 3,525 | 3,913 | 7,114 | 7,630 | 19,716 |
| Bus, transit/intercity | No injury | 36 | 60 | 2,800 | 8,017 | 8,267 | 91 | 11,253 |
| | Possible injury | 4,547 | 345 | 8,404 | 29,743 | 40,075 | 26,131 | 79,502 |
| | Non-incapacitating injury | 10,039 | 528 | 10,790 | 35,827 | 63,233 | 91,357 | 175,947 |
| | Incapacitating injury | 17,331 | 672 | 12,467 | 40,771 | 77,856 | 161,980 | 270,305 |
| | Fatal Injury | 29,936 | 2,075 | 24,574 | 66,573 | 952,161 | 2,342,427 | 3,351,173 |
| | Injury, severity unknown | 4,303 | 555 | 13,442 | 49,799 | 61,946 | 19,499 | 99,745 |
| | Unknown if injured | 1,216 | 121 | 3,982 | 5,391 | 7,969 | 7,170 | 20,458 |

**Table 11. Costs per Crash by Truck/Bus Type (in 1999 dollars).**

| Truck/Bus Type | Medical Costs | Emer-gency Services | Property Damage | Lost Produc-tivity from Delays | Total Lost Produc-tivity | Monetized QALYs | Total |
|---|---|---|---|---|---|---|---|
| Straight truck, no trailer | 3,139 | 150 | 3,959 | 11,583 | 22,444 | 34,973 | 64,667 |
| Straight truck with trailer | 2,217 | 152 | 3,933 | 10,577 | 24,012 | 38,889 | 69,203 |
| Straight truck, unknown if with trailer | 1,448 | 117 | 3,535 | 5,921 | 9,340 | 10,741 | 25,181 |
| Bobtail | 3,341 | 148 | 3,843 | 11,103 | 25,163 | 42,200 | 74,695 |
| Truck-tractor, 1 trailer | 2,525 | 160 | 3,868 | 10,657 | 28,466 | 49,568 | 84,588 |
| Truck-tractor, 2 or 3 trailers | 2,754 | 178 | 3,947 | 10,910 | 37,993 | 72,437 | 117,309 |
| Truck-tractor, with unknown # of trailers | 1,527 | 121 | 3,414 | 7,959 | 19,906 | 30,784 | 55,751 |
| Medium/heavy truck, unknown if with trailer | 1,819 | 128 | 3,515 | 8,763 | 13,786 | 16,699 | 35,948 |
| All large trucks | 2,769 | 156 | 3,913 | 10,993 | 25,760 | 43,039 | 75,637 |
| Bus, transit/intercity | 2,270 | 174 | 4,844 | 14,837 | 22,900 | 24,267 | 54,455 |

**Table 12. Costs per Injury Crash by Truck/Bus Type (in 1999 dollars)**

| Truck/Bus Type | Medical Costs | Emerg-ency Services | Property Damage | Lost Produc-tivity from Delays | Total Lost Produc-tivity | Monetized QALYs | Total |
|---|---|---|---|---|---|---|---|
| Straight truck, no trailer | 9,746 | 315 | 6,212 | 21,150 | 54,735 | 111,394 | 182,404 |
| Straight truck with trailer | 6,816 | 332 | 6,383 | 18,377 | 61,050 | 126,080 | 200,662 |
| Straight truck, unknown if with trailer | 4,977 | 272 | 6,503 | 4,859 | 16,144 | 38,191 | 66,087 |
| Bobtail | 11,111 | 334 | 6,321 | 20,993 | 67,922 | 143,876 | 229,565 |
| Truck-tractor, 1 trailer | 7,626 | 360 | 6,502 | 19,332 | 74,716 | 156,268 | 245,472 |
| Truck-tractor, 2 or 3 trailers | 7,797 | 405 | 6,980 | 20,600 | 99,679 | 213,148 | 328,008 |
| Truck-tractor, with unknown # of trailers | 4,133 | 213 | 4,408 | 9,218 | 43,510 | 90,072 | 142,337 |
| Medium/heavy truck, unknown if with trailer | 4,105 | 222 | 5,045 | 12,316 | 23,511 | 38,699 | 71,581 |
| All large trucks | 8,448 | 343 | 6,409 | 19,908 | 65,739 | 136,066 | 217,005 |
| Bus, transit/intercity | 6,241 | 378 | 8,481 | 26,952 | 48,896 | 67,218 | 131,214 |

**Table 13. Total Crash Costs by Truck/Bus Type: 1997 (in 1999 dollars)**

| Truck/Bus Type | Medical Costs | Emergency Services | Property Damage | Lost Productivity from Delays | Total Lost Productivity | Monetized QALYs | Total |
|---|---|---|---|---|---|---|---|
| Straight truck, no trailer | 410,925,609 | 21,925,212 | 605,615,580 | 1,754,633,438 | 3,023,590,965 | 4,097,371,035 | 8,159,428,402 |
| Straight truck with trailer | 48,903,125 | 2,912,334 | 70,427,328 | 195,646,027 | 468,812,579 | 815,743,198 | 1,406,798,564 |
| Straight truck, unknown if with trailer | – | – | – | – | – | – | – |
| Bobtail | 19,668,249 | 1,367,907 | 40,435,116 | 125,570,523 | 164,578,498 | 126,436,920 | 352,486,690 |
| Truck-tractor, 1 trailer | 436,023,967 | 29,575,165 | 763,765,923 | 2,077,019,020 | 4,665,005,936 | 7,271,946,362 | 13,166,317,352 |
| Truck-tractor, 2 or 3 trailers | 19,805,517 | 1,301,041 | 25,671,809 | 66,897,451 | 365,454,447 | 779,751,440 | 1,191,984,254 |
| Truck-tractor, with unknown # of trailers | 1,644,565 | 150,998 | 4,657,117 | 6,599,714 | 10,173,215 | 10,308,955 | 26,934,849 |
| Medium/heavy truck, unknown if with trailer | 3,665,223 | 314,045 | 9,387,909 | 24,692,838 | 33,706,475 | 25,075,241 | 72,148,893 |
| All large trucks | 940,636,254 | 57,546,702 | 1,519,960,782 | 4,251,059,012 | 8,731,322,115 | 13,126,633,151 | 24,376,099,004 |
| Bus, transit/intercity | 36,167,501 | 3,228,524 | 93,226,729 | 283,158,870 | 432,821,334 | 412,292,371 | 977,736,458 |

# APPENDIX

We also conducted a sensitivity analysis, using the travel delay costs from Miller et al. (1991) instead of the new estimates. The resulting crash costs are presented in the appendix, Tables 14–18. On a percentage basis, costs for low-severity crashes are much more sensitive to this change than costs for severe crashes

**Table 14. Costs per Victim Injured by Truck/Bus Type and Police-Reported Injury Severity (in 1999 dollars)***

| Truck Type Involved in Crash | Injury Severity | Medical Costs | Emergency Services | Property Damage | Lost Productivity from Delays | Total Lost Productivity | Monetized QALYs | Total |
|---|---|---|---|---|---|---|---|---|
| Straight truck, no trailer | No injury | 73 | 33 | 1,276 | 132 | 411 | 262 | 2,054 |
| | Possible injury | 1,144 | 103 | 2,469 | 178 | 2,751 | 5,802 | 12,270 |
| | Non-incapacitating injury | 4,027 | 223 | 3,808 | 225 | 10,933 | 28,956 | 47,947 |
| | Incapacitating injury | 35,810 | 404 | 4,972 | 233 | 45,118 | 242,344 | 328,647 |
| | Fatal Injury | 16,843 | 1,355 | 12,123 | 569 | 750,551 | 2,002,242 | 2,783,114 |
| | Injury, severity unknown | 1,725 | 128 | 2,882 | 193 | 3,411 | 8,466 | 16,612 |
| | Unknown if injured | 1,466 | 90 | 1,983 | 158 | 3,985 | 8,382 | 15,906 |
| Straight truck with trailer | No injury | 93 | 32 | 1,258 | 132 | 435 | 388 | 2,207 |
| | Possible injury | 2,886 | 172 | 3,386 | 211 | 6,733 | 15,581 | 28,758 |
| | Non-incapacitating injury | 5,132 | 232 | 3,967 | 229 | 13,504 | 41,619 | 64,455 |
| | Incapacitating injury | 15,660 | 374 | 4,834 | 233 | 30,099 | 146,239 | 197,207 |
| | Fatal Injury | 17,176 | 1,355 | 12,123 | 569 | 848,170 | 2,247,819 | 3,126,644 |
| | Injury, severity unknown | 11,339 | 215 | 3,522 | 199 | 19,814 | 83,487 | 118,377 |
| | Unknown if injured | 1,018 | 71 | 1,814 | 152 | 2,329 | 6,128 | 11,361 |
| Straight truck, unknown if with trailer | No injury | 73 | 30 | 1,218 | 130 | 388 | 305 | 2,014 |
| | Possible injury | 3,044 | 174 | 3,376 | 211 | 7,676 | 15,717 | 29,987 |
| | Non-incapacitating injury | 4,835 | 229 | 3,977 | 230 | 13,753 | 41,632 | 64,425 |
| | Incapacitating injury | 18,263 | 393 | 4,975 | 234 | 43,117 | 187,669 | 254,417 |
| | Fatal Injury | 22,642 | 1,355 | 12,123 | 569 | 855,695 | 2,038,329 | 2,930,144 |
| | Unknown if injured | 1,003 | 67 | 1,755 | 150 | 2,231 | 6,580 | 11,636 |
| Bobtail | No injury | 71 | 32 | 1,264 | 132 | 401 | 253 | 2,021 |
| | Possible injury | 1,106 | 102 | 2,442 | 177 | 2,694 | 5,615 | 11,958 |
| | Non-incapacitating injury | 3,967 | 223 | 3,804 | 225 | 11,131 | 29,050 | 48,175 |
| | Incapacitating injury | 38,480 | 405 | 4,985 | 233 | 49,364 | 269,782 | 363,015 |
| | Fatal Injury | 17,176 | 1,355 | 12,123 | 569 | 855,695 | 2,247,819 | 3,134,169 |
| | Injury, severity unknown | 1,657 | 126 | 2,836 | 191 | 3,403 | 8,710 | 16,732 |
| | Unknown if injured | 1,468 | 91 | 1,998 | 159 | 4,112 | 8,464 | 16,133 |

| Truck Type Involved in Crash | Injury Severity | Medical Costs | Emergency Services | Property Damage | Lost Productivity from Delays | Total Lost Productivity | Monetized QALYs | Total |
|---|---|---|---|---|---|---|---|---|
| Truck-tractor, 1 trailer | No injury | 91 | 32 | 1,255 | 132 | 431 | 376 | 2,185 |
| | Possible injury | 2,906 | 172 | 3,380 | 211 | 6,903 | 15,803 | 29,165 |
| | Non-incapacitating injury | 5,285 | 234 | 3,975 | 229 | 13,615 | 41,834 | 64,943 |
| | Incapacitating injury | 15,467 | 370 | 4,803 | 233 | 29,481 | 142,888 | 193,008 |
| | Fatal Injury | 16,876 | 1,355 | 12,123 | 569 | 850,481 | 2,143,403 | 3,024,238 |
| | Injury, severity unknown | 6,119 | 137 | 2,481 | 170 | 12,098 | 46,002 | 66,837 |
| | Unknown if injured | 1,034 | 72 | 1,832 | 153 | 2,412 | 6,285 | 11,636 |
| Truck-tractor, 2 or 3 trailers | No injury | 97 | 33 | 1,267 | 132 | 443 | 391 | 2,232 |
| | Possible injury | 2,926 | 173 | 3,382 | 211 | 6,981 | 15,639 | 29,100 |
| | Non-incapacitating injury | 5,283 | 234 | 3,968 | 228 | 13,622 | 42,920 | 66,027 |
| | Incapacitating injury | 15,257 | 370 | 4,805 | 233 | 30,473 | 144,337 | 195,243 |
| | Fatal Injury | 16,748 | 1,355 | 12,123 | 569 | 807,958 | 2,033,696 | 2,871,880 |
| | Injury, severity unknown | 333 | 35 | 1,277 | 132 | 828 | 1,645 | 4,118 |
| | Unknown if injured | 1,041 | 74 | 1,861 | 154 | 2,477 | 6,246 | 11,699 |
| Truck-tractor, unknown # of trailers | No injury | 90 | 32 | 1,253 | 131 | 417 | 364 | 2,156 |
| | Possible injury | 2,967 | 172 | 3,376 | 211 | 7,498 | 16,171 | 30,185 |
| | Non-incapacitating injury | 5,478 | 237 | 4,007 | 230 | 12,201 | 40,381 | 62,304 |
| | Incapacitating injury | 16,060 | 361 | 4,727 | 234 | 32,424 | 130,854 | 184,427 |
| | Fatal Injury | 16,850 | 1,355 | 12,123 | 569 | 777,278 | 1,864,977 | 2,672,584 |
| | Unknown if injured | 1,000 | 65 | 1,721 | 149 | 2,171 | 6,460 | 11,417 |
| Medium/heavy truck, unknown if with trailer | No injury | 76 | 30 | 1,225 | 130 | 393 | 316 | 2,041 |
| | Possible injury | 2,822 | 171 | 3,392 | 211 | 6,467 | 15,618 | 28,470 |
| | Non-incapacitating injury | 4,782 | 226 | 3,935 | 228 | 12,332 | 37,534 | 58,810 |
| | Incapacitating injury | 14,788 | 365 | 4,774 | 232 | 29,653 | 149,144 | 198,725 |
| | Fatal Injury | 17,833 | 1,355 | 12,123 | 569 | 555,799 | 1,822,465 | 2,409,575 |
| | Injury, severity unknown | 3,063 | 71 | 1,597 | 140 | 7,187 | 22,679 | 34,598 |
| | Unknown if injured | 1,015 | 68 | 1,764 | 150 | 2,294 | 6,486 | 11,627 |

| Truck Type Involved in Crash | Injury Severity | Medical Costs | Emergency Services | Property Damage | Lost Productivity from Delays | Total Lost Productivity | Monetized QALYs | Total |
|---|---|---|---|---|---|---|---|---|
| All large trucks | No injury | 85 | 32 | 1,262 | 132 | 423 | 335 | 2,137 |
| | Possible injury | 2,246 | 146 | 3,039 | 198 | 5,343 | 12,048 | 22,822 |
| | Non-incapacitating injury | 4,804 | 230 | 3,912 | 227 | 12,608 | 37,012 | 58,566 |
| | Incapacitating injury | 22,977 | 382 | 4,866 | 233 | 35,390 | 180,352 | 243,967 |
| | Fatal Injury | 16,889 | 1,355 | 12,123 | 569 | 821,329 | 2,100,377 | 2,952,073 |
| | Injury, severity unknown | 4,177 | 133 | 2,658 | 180 | 8,232 | 29,374 | 44,574 |
| | Unknown if injured | 1,154 | 77 | 1,871 | 154 | 2,849 | 6,879 | 12,830 |
| Bus, transit/intercity | No injury | 14 | 23 | 1,100 | 126 | 223 | 34 | 1,394 |
| | Possible injury | 2,440 | 168 | 3,600 | 219 | 5,613 | 13,818 | 25,639 |
| | Non-incapacitating injury | 5,807 | 251 | 4,108 | 221 | 16,876 | 58,175 | 85,217 |
| | Incapacitating injury | 10,275 | 298 | 4,503 | 231 | 21,495 | 103,396 | 139,968 |
| | Fatal Injury | 22,642 | 1,355 | 12,123 | 569 | 792,728 | 2,074,193 | 2,903,041 |
| | Injury, severity unknown | 1,328 | 161 | 3,603 | 222 | 4,119 | 6,215 | 15,425 |
| | Unknown if injured | 1,113 | 77 | 1,958 | 158 | 2,378 | 6,212 | 11,739 |

* Note Travel delay costs from Miller et al. (1991)

**Table 15. Costs per Crash by Truck/Bus Type and Crash Severity (in 1999 dollars)***

| Truck Type Involved in Crash | Injury Severity | Medical Costs | Emergency Services | Property Damage | Lost Productivity from Delays | Total Lost Productivity | Monetized QALYs | Total |
|---|---|---|---|---|---|---|---|---|
| Straight truck, no trailer | No injury | 160 | 74 | 2,911 | 304 | 914 | 571 | 4,630 |
| | Possible injury | 1,648 | 189 | 5,255 | 440 | 4,329 | 8,122 | 19,543 |
| | Non-incapacitating injury | 5,276 | 338 | 6,808 | 477 | 14,422 | 36,904 | 63,748 |
| | Incapacitating injury | 44,643 | 611 | 9,051 | 531 | 58,781 | 302,291 | 415,376 |
| | Fatal Injury | 35,371 | 1,772 | 18,087 | 935 | 865,302 | 2,352,174 | 3,272,706 |
| | Injury, severity unknown | 2,540 | 213 | 5,457 | 433 | 5,772 | 12,982 | 26,964 |
| | Unknown if injured | 1,673 | 133 | 3,541 | 319 | 4,763 | 9,271 | 19,381 |
| Straight truck with trailer | No injury | 206 | 73 | 2,855 | 299 | 977 | 863 | 4,974 |
| | Possible injury | 3,717 | 263 | 6,167 | 651 | 27,292 | 19,601 | 57,040 |
| | Non-incapacitating injury | 6,433 | 333 | 6,641 | 469 | 8,904 | 50,336 | 72,647 |
| | Incapacitating injury | 19,593 | 548 | 8,858 | 459 | 17,007 | 179,748 | 225,754 |
| | Fatal Injury | 25,677 | 1,731 | 17,933 | 939 | 866,319 | 2,261,505 | 3,173,165 |
| | Injury, severity unknown | 15,375 | 348 | 7,892 | 651 | 27,292 | 113,546 | 164,453 |
| | Unknown if injured | 1,203 | 114 | 3,398 | 315 | 2,967 | 6,955 | 14,637 |
| Straight truck, unknown if with trailer | No injury | 146 | 60 | 2,441 | 261 | 790 | 626 | 4,062 |
| | Possible injury | 2,109 | 154 | 3,891 | 320 | 4,977 | 11,120 | 22,251 |
| | Non-incapacitating injury | 6,654 | 364 | 7,589 | 545 | 18,600 | 55,252 | 88,458 |
| | Incapacitating injury | 14,282 | 387 | 6,071 | 361 | 35,223 | 138,716 | 194,680 |
| | Fatal Injury | 24,118 | 1,542 | 16,236 | 862 | 617,994 | 1,709,226 | 2,369,116 |
| | Unknown if injured | 3,741 | 278 | 6,980 | 582 | 8,631 | 23,999 | 43,629 |
| Bobtail | No injury | 155 | 72 | 2,817 | 295 | 882 | 549 | 4,475 |
| | Possible injury | 1,509 | 176 | 4,930 | 417 | 4,046 | 7,376 | 18,037 |
| | Non-incapacitating injury | 5,604 | 364 | 7,362 | 520 | 15,896 | 40,039 | 69,265 |
| | Incapacitating injury | 45,630 | 577 | 8,543 | 502 | 60,956 | 319,826 | 435,533 |
| | Fatal Injury | 36,033 | 1,761 | 17,849 | 919 | 920,407 | 2,420,455 | 3,396,504 |
| | Injury, severity unknown | 1,825 | 162 | 4,150 | 325 | 3,872 | 9,335 | 19,343 |
| | Unknown if injured | 1,540 | 127 | 3,513 | 322 | 4,367 | 8,728 | 18,275 |

| Truck Type Involved in Crash | Injury Severity | Medical Costs | Emergency Services | Property Damage | Lost Productivity from Delays | Total Lost Productivity | Monetized QALYs | Total |
|---|---|---|---|---|---|---|---|---|
| Truck-tractor, 1 trailer | No injury | 191 | 68 | 2,660 | 279 | 907 | 788 | 4,613 |
| | Possible injury | 3,810 | 262 | 6,010 | 450 | 9,317 | 20,489 | 39,888 |
| | Non-incapacitating injury | 6,761 | 341 | 6,683 | 455 | 17,470 | 51,444 | 82,699 |
| | Incapacitating injury | 19,360 | 525 | 7,992 | 473 | 37,977 | 176,511 | 242,366 |
| | Fatal Injury | 26,308 | 1,761 | 18,057 | 938 | 914,159 | 2,365,564 | 3,325,849 |
| | Injury, severity unknown | 7,444 | 184 | 3,879 | 310 | 14,306 | 54,492 | 80,305 |
| | Unknown if injured | 1,186 | 118 | 3,557 | 332 | 3,057 | 6,929 | 14,846 |
| Truck-tractor, 2 or 3 trailers | No injury | 183 | 62 | 2,399 | 250 | 839 | 735 | 4,217 |
| | Possible injury | 3,796 | 262 | 6,040 | 454 | 9,351 | 20,066 | 39,515 |
| | Non-incapacitating injury | 7,083 | 362 | 7,163 | 491 | 18,096 | 54,166 | 86,870 |
| | Incapacitating injury | 18,472 | 525 | 8,129 | 486 | 38,059 | 171,808 | 236,991 |
| | Fatal Injury | 25,751 | 1,764 | 18,091 | 940 | 992,703 | 2,462,275 | 3,500,585 |
| | Injury, severity unknown | 504 | 44 | 1,447 | 143 | 1,174 | 2,491 | 5,660 |
| | Unknown if injured | 1,108 | 107 | 3,199 | 297 | 2,874 | 6,414 | 13,702 |
| Truck-tractor, unknown # of trailers | No injury | 209 | 74 | 2,908 | 305 | 953 | 817 | 4,961 |
| | Possible injury | 3,172 | 203 | 4,479 | 324 | 8,195 | 17,583 | 33,632 |
| | Non-incapacitating injury | 7,421 | 382 | 7,681 | 534 | 17,093 | 51,591 | 84,167 |
| | Incapacitating injury | 15,383 | 403 | 6,795 | 462 | 33,551 | 131,674 | 187,807 |
| | Fatal Injury | 24,588 | 1,689 | 17,640 | 933 | 899,618 | 2,260,946 | 3,204,481 |
| | Unknown if injured | 1,123 | 106 | 3,275 | 309 | 2,722 | 6,933 | 14,158 |
| Medium/heavy truck, unknown if with trailer | No injury | 142 | 59 | 2,381 | 254 | 741 | 574 | 3,896 |
| | Possible injury | 4,506 | 303 | 6,805 | 494 | 10,433 | 24,865 | 46,911 |
| | Non-incapacitating injury | 6,541 | 351 | 7,070 | 487 | 16,905 | 48,953 | 79,820 |
| | Incapacitating injury | 31,317 | 853 | 12,130 | 643 | 65,294 | 313,119 | 422,713 |
| | Fatal Injury | 25,946 | 1,703 | 17,704 | 929 | 869,923 | 2,291,273 | 3,206,548 |
| | Injury, severity unknown | 9,424 | 345 | 9,695 | 922 | 22,739 | 68,285 | 110,487 |
| | Unknown if injured | 1,197 | 111 | 3,399 | 320 | 2,979 | 7,402 | 15,088 |

| Truck Type Involved in Crash | Injury Severity | Medical Costs | Emergency Services | Property Damage | Lost Productivity from Delays | Total Lost Productivity | Monetized QALYs | Total |
|---|---|---|---|---|---|---|---|---|
| All large trucks | No injury | 182 | 70 | 2,764 | 290 | 915 | 718 | 4,649 |
| | Possible injury | 3,051 | 237 | 5,778 | 449 | 7,564 | 16,124 | 32,755 |
| | Non-incapacitating injury | 6,285 | 344 | 6,813 | 469 | 16,553 | 46,694 | 76,689 |
| | Incapacitating injury | 28,685 | 560 | 8,454 | 499 | 45,978 | 224,204 | 307,881 |
| | Fatal Injury | 28,429 | 1,757 | 17,975 | 934 | 927,194 | 2,401,793 | 3,377,148 |
| | Injury, severity unknown | 5,357 | 199 | 4,669 | 374 | 10,610 | 36,814 | 57,648 |
| | Unknown if injured | 1,326 | 121 | 3,525 | 326 | 3,527 | 7,630 | 16,129 |
| Bus, transit/intercity | No injury | 36 | 60 | 2,800 | 319 | 570 | 91 | 3,556 |
| | Possible injury | 4,547 | 345 | 8,404 | 612 | 10,944 | 26,131 | 50,371 |
| | Non-incapacitating injury | 10,039 | 528 | 10,790 | 732 | 28,138 | 91,357 | 140,852 |
| | Incapacitating injury | 17,331 | 672 | 12,467 | 779 | 37,863 | 161,980 | 230,312 |
| | Fatal Injury | 29,936 | 2,075 | 24,574 | 1,320 | 886,908 | 2,342,427 | 3,285,920 |
| | Injury, severity unknown | 4,303 | 555 | 13,442 | 932 | 13,079 | 19,499 | 50,878 |
| | Unknown if injured | 1,216 | 121 | 3,982 | 391 | 2,969 | 7,170 | 15,457 |

* Note Travel delay costs from Miller et al. (1991)

**Table 16. Costs per Crash by Truck/Bus Type (in 1999 dollars)***

| Truck/Bus Type | Medical Costs | Emerg-ency Services | Property Damage | Lost Produc-tivity from Delays | Total Lost Produc-tivity | Monetized QALYs | Total |
|---|---|---|---|---|---|---|---|
| Straight truck, no trailer | 3,139 | 150 | 3,959 | 352 | 11,213 | 34,973 | 53,435 |
| Straight truck with trailer | 2,217 | 152 | 3,933 | 348 | 13,783 | 38,889 | 58,974 |
| Straight truck, unknown if with trailer | 1,448 | 117 | 3,535 | 333 | 3,753 | 10,741 | 19,594 |
| Bobtail | 3,341 | 148 | 3,843 | 342 | 14,402 | 42,200 | 63,934 |
| Truck-tractor, 1 trailer | 2,525 | 160 | 3,868 | 333 | 18,143 | 49,568 | 74,265 |
| Truck-tractor, 2 or 3 trailers | 2,754 | 178 | 3,947 | 326 | 27,409 | 72,437 | 106,725 |
| Truck-tractor, with unknown # of trailers | 1,527 | 121 | 3,414 | 321 | 12,267 | 30,784 | 48,112 |
| Medium/heavy truck, unknown if with trailer | 1,819 | 128 | 3,515 | 315 | 5,339 | 16,699 | 27,501 |
| All large trucks | 2,769 | 156 | 3,913 | 341 | 15,108 | 43,039 | 64,985 |
| Bus, transit/intercity | 2,270 | 174 | 4,844 | 426 | 8,489 | 24,267 | 40,045 |

* Note Travel delay costs from Miller et al. (1991)

**Table 17. Costs per Injury Crash by Truck/Bus Type (in 1999 dollars)***

| Truck/Bus Type | Medical Costs | Emerg-ency Services | Property Damage | Lost Produc-tivity from Delays | Total Lost Produc-tivity | Monetized QALYs | Total |
|---|---|---|---|---|---|---|---|
| Straight truck, no trailer | 9,746 | 315 | 6,212 | 454 | 34,039 | 111,394 | 161,707 |
| Straight truck with trailer | 6,816 | 332 | 6,383 | 459 | 43,132 | 126,080 | 182,744 |
| Straight truck, unknown if with trailer | 4,977 | 272 | 6,503 | 530 | 11,815 | 38,191 | 61,757 |
| Bobtail | 11,111 | 334 | 6,321 | 456 | 47,385 | 143,876 | 209,028 |
| Truck-tractor, 1 trailer | 7,626 | 360 | 6,502 | 450 | 55,834 | 156,268 | 226,591 |
| Truck-tractor, 2 or 3 trailers | 7,797 | 405 | 6,980 | 474 | 79,553 | 213,148 | 307,883 |
| Truck-tractor, with unknown # of trailers | 4,133 | 213 | 4,408 | 351 | 34,642 | 90,072 | 133,469 |
| Medium/heavy truck, unknown if with trailer | 4,105 | 222 | 5,045 | 396 | 11,591 | 38,699 | 59,662 |
| All large trucks | 8,448 | 343 | 6,409 | 453 | 46,284 | 136,066 | 197,550 |
| Bus, transit/intercity | 6,241 | 378 | 8,481 | 615 | 22,559 | 67,218 | 104,877 |

* Note Travel delay costs from Miller et al. (1991)

**Table 18. Total Crash Costs by Truck/Bus Type: 1997 (in 1999 dollars)***

| Truck/Bus Type | Medical Costs | Emergency Services | Property Damage | Lost Productivity from Delays | Total Lost Productivity | Monetized QALYs | Total |
|---|---|---|---|---|---|---|---|
| Straight truck, no trailer | 410,925,609 | 21,925,212 | 605,615,580 | 45,106,581 | 1,438,963,528 | 4,097,371,035 | 6,574,800,964 |
| Straight truck with trailer | 48,903,125 | 2,912,334 | 70,427,328 | 4,295,535 | 170,077,016 | 815,743,198 | 1,108,063,001 |
| Straight truck, unknown if with trailer | – | – | – | – | – | – | – |
| Bobtail | 19,668,249 | 1,367,907 | 40,435,116 | 6,736,052 | 283,773,001 | 126,436,920 | 471,681,193 |
| Truck-tractor, 1 trailer | 436,023,967 | 29,575,165 | 763,765,923 | 56,485,046 | 3,079,087,566 | 7,271,946,362 | 11,580,398,982 |
| Truck-tractor, 2 or 3 trailers | 19,805,517 | 1,301,041 | 25,671,809 | 1,536,699 | 129,297,584 | 779,751,440 | 955,827,391 |
| Truck-tractor, with unknown # of trailers | 1,644,565 | 150,998 | 4,657,117 | 387,664 | 14,825,473 | 10,308,955 | 31,587,108 |
| Medium/heavy truck, unknown if with trailer | 3,665,223 | 314,045 | 9,387,909 | 1,503,533 | 25,512,841 | 25,075,241 | 63,955,259 |
| All large trucks | 940,636,254 | 57,546,702 | 1,519,960,782 | 116,297,253 | 5,150,951,716 | 13,126,633,151 | 20,795,728,605 |
| Bus, transit/intercity | 36,167,501 | 3,228,524 | 93,226,729 | 10,290,559 | 205,041,915 | 412,292,371 | 749,957,039 |

* Note Travel delay costs from Miller et al. (1991)

# REFERENCES


Association for the Advancement of Automotive Medicine. (1985). The Abbreviated Injury Scale 1985. Des Plaines, IL: Association for the Advancement of Automotive Medicine.

Association for the Advancement of Automotive Medicine. (1990). The Abbreviated Injury Scale 1990. Des Plaines, IL: Association for the Advancement of Automotive Medicine.

Berkowitz, M., Harvey, C., Greene, C., & Wilson, S. (1990). The Economic Consequences of Spinal Cord Injury. Washington, DC: Paralysis Society of America of the Paralyzed Veterans of America.

Blincoe, L.J. (1996). *The Economic Costs of Motor Vehicle Crashes 1994*. (Document No. DOT HS 808 425). Washington, DC: U.S. Department of Transportation, NHTSA.

Blincoe, L.J., & Faigin, B.M. (1992). The Economic Cost of Motor Vehicle Crashes, 1990. (Document No. DOT HS 807 876). Washington, DC: U.S. Department of Transportation, NHTSA.

Bureau of the Census. (1994). *Statistical Abstract of the United States 1994.* Washington, DC: U.S. Government Printing Office.

Bureau of the Census (1999). *1997 Economic Census: Vehicle Inventory and Use Survey.* Washington, DC: U.S. Government Printing Office.

Council of Economic Advisers (2000). *Economic Report of the President*. US Government Printing Office, Washington, DC.

Garthe, E.A., Ferguson, S.A., & Early, N. (1996). A Method for Converting Injury Severity in NASS93 (AIS90) to NASS88 (AIS85). In *40th Annual Proceedings.* Des Plaines, IL: Association for the Advancement of Automotive Medicine, pp. 477–494.

Hensler, D.R., Marquis, M.S., Abrahams, A.F., Berry, S.H., Ebener, P.A., Lewis, E.G., Ling, E.A., MacCoun, R.J., Manning, W.G., Rogowski, J.A., & Vaiana, M.E. (1991). Compensation for Accidental Injuries in the United States. (Report R-3999-HHS/ICJ). Santa Monica, CA: RAND.

Kakalik, J.S., & Pace, N.M. (1986). Costs and Compensation Paid in Tort Litigation. (Report R-3391-ICJ). anta Monica, CA: RAND.

Krusei, F.E., & McFadden, N.E. (1996). *Update of Value of Life and Injuries for Use in Preparing Economic Evaluations.* Washington, DC: Office of the Secretary of Transportation.

Lan, C-J., & Hu, P.S. (2000). Personal communications.

Lawrence, B., Miller, T.R., Jensen, A., Fisher, D., & Zamula, W. (1999). Estimating the Costs of Nonfatal Consumer Product Injuries in the United States, *Proceedings of the 7th International Conference on Product Safety Research,* 40–68

McCormick, W., & Shane, J. (1993). *Treatment of Value of Life and Injuries in Preparing Economic Evaluations.* Washington, DC: Office of the Secretary of Transportation.

Miller, T.R. (1993). Costs and Functional Consequences of US Roadway Crashes. *Accident Analysis and Prevention*. 25, 593–607.

Miller, T.R. (1997). Societal Costs of Transportation Crashes. In D. Greene, D. Jones, M. Delucchi (Eds.), *The Full Social Costs and Benefits of Transportation*. Heidelberg: Springer-Verlag, pp. 281–314.

Miller, T.R., & Blincoe, L.J. (1994). Incidence and Cost of Alcohol-Involved Crashes in the United States. *Accident Analysis and Prevention*, 26:583–592.

Miller, T.R., Galbraith, M.S., Lestina, D.C., Schlax, T., Mabery, P., Deering, R., Massie, D., & Campbell, K. (1995). Understanding the Harm from US Motor Vehicle Crashes. *39th Proceedings.* Des Plaines, IL: Association for the Advancement of Automotive Medicine, pp. 327–342.

Miller, T.R., Lawrence, B., Jensen, A., Waehrer, G., Spicer, R., Lestina, D., & Cohen, M. (1998). Estimating the Cost to Society of Consumer Product Injuries: The Revised Injury Cost Model. Bethesda, MD: US Consumer Product Safety Commission.

Miller, T.R., Lestina, D.C. & Spicer, R.S. (1998). Highway Crash Costs in the United States by Driver age, Blood Alcohol Level, Victim Age and Restraint Use. *Accident Analysis and Prevention*, 30(2), 137–150.

Miller, T.R., Levy, D.T., Spicer, R.S., & Lestina, D.C. (1998). Allocating the Costs of Motor Vehicle Crashes between Vehicle Types, *Transportation Research Record*, 1635, 81–87.

Miller, T., Pindus, N., & Douglass, J. (1993). Motor Vehicle Injury Costs by Body Region and Severity. *J. Trauma*, 3, 270–275.

Miller, T.R., Pindus, N., Douglass, J., & Rossman, S. (1995). *Databook on Nonfatal Injury – Incidence, Costs, and Consequences*. Washington, DC: The Urban Institute Press.

Miller, T.R., Romano, E., & Spicer, R.S. (2000). The Cost of Unintentional Childhood Injuries and the Value of Prevention. *The Future of Children*, 10(1), 137–163.

Miller, T.R., Spicer R.S., D Lestina, D.C., & Levy, D.T. (1999). Is It Safest to Travel by Bicycle, Car or Big Truck? *Journal of Crash Prevention and Injury Control*, 1(1), 25–34.

Miller, T.R., Viner, J., Rossman, S., Pindus, N., Gellert, W., Dillingham, A., & Blomquist, G. (1991). *The Costs of Highway Crashes*. Washington DC: The Urban Institute.

Miller T.R., Whiting, B., Kragh, B., & Zegeer, C. (1987). Sensitivity of a Highway Safety Resource Allocation Model to Variations in Benefit Computation Parameters. *Transportation Research Record,* 1124, 58–65.

NHTSA. (1987). National Accident Sampling System 1986. Washington, DC: U.S. Department of Transportation, NHTSA.

NHTSA. (1995). National Accident Sampling System Crashworthiness Data System 1991–1993. Washington, DC: U.S. Department of Transportation, NHTSA.

National Safety Council. (1990). *Manual on Classification of Motor Vehicle Traffic Accidents, Fifth Edition*. (ANSI D-16.1-1989). Itasca, IL: National Safety Council.

O'Day, J. (Ed.). (1993). *Accident Data Quality: A Synthesis of Highway Practice*. (National Cooperative Highway Research Program Synthesis 192). Washington, DC: Transportation Research Board, National Research Council, National Academy Press.

Rice, D.P., MacKenzie, E.J., Jones, A.S., Kaufman, S.R., deLissovoy, G.V., Max, W., McLoughlin, E., Miller, T.R., Robertson, L.S., Salkever, D.S., & Smith, G.S. (1989). Cost of Injury in the United States: A Report to Congress. San Francisco, CA: Institute for Health & Aging, University of California, and Injury Prevention Center, The Johns Hopkins University.

U.S. Department of Transportation. (1997). The Value of Travel Time: Departmental Guidance for Conducting Economic Evaluations. Washington, DC: U.S. Department of Transportation, Office of the Secretary of Transportation.

Viner, J.G., & Conley, C. (1994). Consistency of Police Reported "Incapacitating Injuries" between States. (Working paper). Washington, DC: U.S. Department of Transportation, Federal Highway Administration.