



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



**DOT HS 809 058  
NHTSA Report**

**June 2000**

# **Revised Catalog of Types of CODES Applications Implemented Using Linked State Data**

## **Crash Outcome Data Evaluation System (CODES)**

This publication is distributed by the U.S. Department of Transportation, National Highway Traffic Safety Administration, in the interest of information exchange. The opinions, findings and conclusions expressed in this publication are those of the author(s) and not necessarily those of the Department of Transportation or the National Highway Traffic Safety Administration. The United States Government assumes no liability for its contents or use thereof. If trade or manufacturer's name or products are mentioned, it is because they are considered essential to the object of the publication and should not be construed as an endorsement. The United States Government does not endorse products or manufacturers.

1. Report No. <b>DOT HS 809 058</b>	2. Government Accession No.	3. Recipients's Catalog No.	
4. Title and Subtitle  <b>Revised Catalog of Types of CODES Applications Implemented Using Linked State Data</b>		5. Report Date  <b>June 2000</b>	
		6. Performing Organization Code	
7. Author(s)	8. Performing Organization Report No.		
9. Performing Organization Name and Address <b>National Center for Statistics and Analysis NHTSA 400 Seventh Street, S.W. Washington, DC 20590</b>		10. Work Unit No. (TRAIS)n code	
		11. Contract of Grant No.	
12. Sponsoring Agency Name and Address <b>National Highway Traffic Safety Administration 400 Seventh Street, S.W. Washington, DC 20590</b>		13. Type of Report and Period Covered	
		14. Sponsoring Agency Code	
15. Supplementary Notes			
16. Abstract  <p>The purpose of the <i>Revised Catalog of Types of CODES Applications Implemented Using Linked State Data (CODES)</i> is to inspire the development of new applications for linked data that support efforts to reduce death, disability, severity, and health care costs related to motor vehicle crashes. The document is divided into three sections. The Introduction describes the purpose of the Catalog, the evolution and components of CODES, and the CODES states. The Background section discusses data resources and case selection, issues related to "as reported" data and the linkage process, and the organization of information included in the catalog. The final section presents abstracts of the types of state-specific applications developed or 'in process" as of June 2000. NHTSA will update the catalog on a periodic basis as the CODES states develop new applications.</p>			
17. Key Words <b>Data linkage, CODES, CODES applications,</b>		18. Distribution Statement <b>Document is available to the public through NHTSA, NRD-33 400 Seventh St., SW Room 6125 Washington, DC 20590 or at: 1.800.934.8517</b>	
19. Security Classif. (of this report) <b>Unclassified</b>	20. Security Classif. (of this page) <b>Unclassified</b>	21. No of Pages	22. Price



# TABLE OF CONTENTS

## 1.0 INTRODUCTION

<b>1.1 Purpose of the Catalog</b> .....	1
<b>1.2 Evolution of CODES</b> .....	1
<b>1.3 A Description of CODES</b> .....	1
<b>1.4 First Implementation of CODES</b> .....	2

## 2.0 BACKGROUND

<b>2.1 Data Resources and Case Selection</b> .....	3
<b>2.2 Issues Related to “As Reported” Data and the Linkage Process</b> .....	4
2.2.1 Utilization of Safety Measures .....	4
2.2.2 Defining an Injury .....	4
2.2.3 Identifying the Type of Injury .....	4
2.2.4 Identifying Costs and Charges .....	4
2.2.5 The Linkage Process: .....	5
<b>2.3 Organization of the Catalog</b> .....	5

## 3.0 APPLICATIONS FOR INJURY PREVENTION

<b>3.1 Evaluating the Occurrence of Injury</b> .....	7
3.1.1 By Age .....	7
Management Reports	
<i>Total Victims and Total Hospital Charges by Restraint Used, Type of Crash, and Injury Severity Level(KABCO) for Children (12-17 years) Injured in Motor Vehicle Crashes in New Hampshire</i> .....	7
<i>Injury Rates and Outcome for Males by Age in 1995 Crashes in Maine</i> .....	7
<i>Injury Rates and Outcome for Females by Age in 1995 Crashes in Maine</i> .....	8
3.1.2 Involving Pedestrians .....	8
Fact Sheets	
<i>1998 Utah Crash Facts - Pedestrians</i> .....	8
Management Reports	
<i>Injury Outcome by Age Group for Male Pedestrians in 1996 Crashes in Maine</i> .....	9

<i>Injury Outcome by Age Group for Female Pedestrians in 1996 Crashes in Maine</i>	9
<i>Injury Outcome by County of Crash Location for Pedestrians Involved in 1996 Crashes in Maine</i>	10
<i>Injury Outcome by Month of Crash for Pedestrians in Crashes in Maine</i>	10
<i>Injury Outcome by Day of Week of Crash for Pedestrians in Crashes in Maine</i>	11
<i>Injury Outcome by Time of Crash (1 hour intervals) for Pedestrians in Crashes in Maine</i>	11
<i>Injury Outcome for Pedestrians Involved in Alcohol-Related Crashes in Maine</i>	12
<i>Injury Outcome for Pedestrians Involved in Motor Vehicle Crashes by Population Density of Crash Location in Maine</i>	12
<i>Injury Outcome for Pedestrians Involved in Crashes by Roadway Location of Crash in Maine</i>	13
<i>Injury Outcome for Pedestrians Involved in Motor Vehicle Crashes by Apparent Contributing Factor in Maine</i>	13
3.1.3 Involving Bicyclists	14
Management Reports	
<i>Injury Outcome by Age Group for Male Bicyclists Involved in 1996 Crashes in Maine</i>	14
<i>Injury Outcome by Age Group for Female Bicyclists Involved in 1996 Crashes in Maine</i>	14
<i>Injury Outcome by County of Crash Location for Bicyclists Involved in 1996 Crashes in Maine</i>	15
<i>Injury Outcome by Month of Crash for Bicyclists Involved in Crashes in Maine</i>	15
<i>Injury Outcome by Day of Week of Crash for Bicyclists Involved in Crashes in Maine</i>	16
<i>Injury Outcome by Time of Crash (1 hour intervals) for Bicyclists Involved in Crashes in Maine</i>	16
<i>Injury Outcome for Bicyclists Involved in Alcohol-Related Crashes in Maine</i>	17
<i>Injury Outcome for Bicyclists Involved in Motor Vehicle Crashes by Population Density of Crash Location in Maine</i>	17
<i>Injury Outcome for Bicyclists Involved in Crashes by Roadway Location of Crash in Maine</i>	18
<i>Injury Outcome for Bicyclists Involved in Motor Vehicle Crashes by Apparent Contributing Factor in Maine</i>	18
3.1.4 Involving Motorcyclists	19
Study	
<i>Statewide Study of Injured Motorcyclists in Maryland</i>	19

Management Reports	
<i>Injury Outcome by Age Group for Motorcyclists Involved in 1996 Crashes in Maine</i>	19
3.1.5 By Geographic Location	20
Studies	
<i>Analysis of the Medical and Financial Outcomes of Motor Vehicle Crash/Injuries in Connecticut</i>	20
<i>Linked Data and GIS Using an Access Data Base in Connecticut</i>	20
<i>1996 Motor Vehicle Crash Injuries and Hospital Charges in Rural and Urban Areas in Nebraska</i>	21
<i>Issues Surrounding GIS Issues and Traffic Crashes in South Carolina</i>	21
<i>Using Linked Data to Support Safe Communities in South Dakota (in process)</i>	22
<i>Observing if the Safe Communities Are “Getting It” in Wisconsin</i>	22
Management Reports	
<i>Injury Outcome by County of Crash Location in Maine</i>	23
<i>Injury Outcome by Hospital Service Area of Crash Location in Maine</i>	23
<i>Injury Outcome by Population Density of Crash Location in Maine</i>	24
<i>Injury Rates and Outcomes by Safe Community Area in South Carolina</i>	24
3.1.6 By Date and Time	25
Management Reports	
<i>Injury Outcome by Month of Crash in Maine</i>	25
<i>Injury Outcome by Day of Week of Crash in Maine</i>	25
<i>Injury Outcome by Time of Crash in Maine</i>	26
3.1.7 By Type of Injury	26
Studies	
<i>Case-Control Analysis of Traumatic Brain Injury in Motor Vehicle Crashes in Kentucky (In Process)</i>	26
<i>Lower Extremity Fractures Among Restrained Vehicle Occupants in Maryland</i>	27
<i>Use of CODES Linked Data to Evaluate Traumatic Brain Injury in New Mexico</i>	27
<i>Serious Lower Extremity Injuries in Motor vehicle Crashes In Wisconsin</i>	28
<i>Evaluating the Impact of Reported Seat Belt Use on Hospitalizations and Subsequent Deaths Resulting from Brain Injuries in Wisconsin</i>	28

3.1.8 By Type of Treatment for Injury .....29

    Studies

*Investigating Auto Injury Treatment in a No-fault State: An Analysis  
        Of Linked Crash and Auto Insurer Data in Hawaii* ..... 29

**3.2 Health Care Costs** ..... 29

3.2.1 Costs and Safety Belt Use ..... 29

    Studies

*Focus...Injuries and Costs Associated with Failure to Use Seat Belts  
        in Missouri* ..... 29

*Analysis of Collision Seat Belt Use and Average Hospital Charge 1995-96  
        in Nevada (in process)* ..... 30

    Management Reports

*Charges by Belt Use by Payer Source in Wisconsin* ..... 30

3.2.2 Hospital Charges ..... 31

    Studies

*Comparative Analysis of Hospital Charges Among Motor Vehicle Crashes  
        in Maryland* ..... 31

*Using Path Analysis to Identify Direct and Indirect Effects of Motor Vehicle  
        Crash in Nebraska* ..... 31

*Using Linked Data to Evaluate Hospital Charges for Motor Vehicle Crash  
        Victims in Pennsylvania* ..... 32

    Fact Sheets

*Total and Average Hospital Charges by County of the Crash Location in  
        Iowa* ..... 32

*Total and Average Hospital Charges by Age Group for Persons Involved  
        in Motor Vehicle Crashes in Iowa* ..... 33

*Total Hospital Charges by Type of Crash in Iowa* ..... 33

*Total Occurrences, Total and Average Hospital Charges by Type of  
        Non-Collision Motor Vehicle Crash in Iowa* ..... 34

3.2.3 Medicaid and Costs ..... 34

    Studies

*The Cost of Motor Vehicle Crash Injuries to the Wisconsin Medicaid Program* ..... 34



3.2.4 Vehicle Insurance Claims .....	35
--------------------------------------	----

Studies

<i>Community Crash Injury Profiles Using Unlinked and Linked Hospital, Insurance and Crash Data - Massachusetts 1996</i> .....	35
--	----

**4.0 APPLICATIONS FOR TRAFFIC SAFETY**

<b>4.1 Crash Characteristics</b> .....	36
--	----

Studies

<i>Crash and Injury Outcome Multipliers In Hawaii</i> .....	36
<i>Analysis of 1996 Crashes Where Vehicles “Ran Off the Road” in Maine</i> .....	37
<i>Patterns of Injury in Frontal Collisions With and Without Airbags in Maryland</i> .....	37
<i>Overturn Crashes and Injury in New Mexico</i> .....	38
<i>Crash Parameters and Cost of Care in New York ( in process)</i> .....	38

Fact Sheets

<i>Drivers Who Ran Off the Road, Maine Crash Facts, 1996</i> .....	39
--	----

Management Reports

<i>Injury Outcome by Posted Speed Limit in Maine</i> .....	39
<i>Injury Outcome by Type of Crash in Maine</i> .....	40
<i>Injury Outcome by Roadway Location of Crash in Maine</i> .....	40
<i>Injury Outcome by Light Conditions of Crash in Maine</i> .....	41
<i>Injury Outcome by Road Surface of Crash in Maine</i> .....	41
<i>Injury Outcome by Type of Road Work at Crash in Maine</i> .....	42
<i>Injury Outcome by Apparent Contributing Factors in Single Vehicle Crashes in Maine</i> .....	42
<i>Injury Outcome by Apparent Contributing Factors in Multiple Vehicle Crashes in Maine</i> .....	43

<b>4.2 Vehicle Characteristics</b> .....	43
--	----

Studies

<i>Using Linked Data to Support Truck Safety in South Dakota (in process)</i> .....	43
---	----

Management Reports

<i>Injury Outcome by Vehicle Type for Crashes in Maine</i> .....	44
<i>Injury Outcome by Type of Emergency Vehicle Involved in Crash in Maine</i> .....	44

<b>4.3 Person Characteristics</b> .....	45
4.3.1 Safety Belts .....	45
Studies	
<i>Report to Congress on Benefits of Safety Belts and Motorcycle Helmets, Based on Data from the Crash Outcome Data Evaluation System (CODES)</i> .....	45
<i>NHTSA Technical Report: The Crash Outcome Evaluation System (CODES)</i> .....	45
<i>Analysis of Seat Belt Use and Outcomes in Maine Crashes in 1996</i> .....	46
<i>Safety Belts and Head and Spinal Injuries in Maine</i> .....	46
<i>Within Vehicle Analysis of the Effectiveness of Seat Belts in Maine</i> .....	47
<i>Application of Ordered Logistic Regression to Evaluate the Efficacy of Seat Belts and Helmets for Prevention of Injury in Maine</i> .....	47
<i>Unsafe Driving Behaviors and Hospitalization in Missouri.</i> .....	48
<i>Motor Vehicle Crashes in 1995-1996 and Their Outcomes by Safety Belt Use Statewide in Oklahoma</i> .....	48
<i>Analysis of Seat Belt Usage on Motor Vehicle Crash-Related Injuries Using a Model of Injury Severity Based Upon EMS Intervention in Utah.</i> .....	49
<i>Seat Belt and Airbag Effectiveness in Motor Vehicle Crashes Vary Little With Driver Height or Weight in Utah</i> .....	49
<i>Shoulder Belts in Motor Vehicle Crashes: A Statewide Analysis of Restraint Efficacy in Utah</i> .....	50
<i>Children in Motor Vehicle Crashes: Decreasing Protection with Increasing Age in Utah</i> .....	50
Fact Sheets	
<i>Do Seat Belts Reduce Injuries? Maine Crash Facts, 1996</i> .....	51
<i>Ejections: Dangerous, Costly and Preventable in Missouri</i> .....	51
<i>1998 Utah Crash Facts: Occupant Protection.</i> .....	52
Management Reports	
<i>Injury Outcome by Safety Equipment Usage for Persons Involved in Crashes in Maine</i> .....	52
<i>Injury Outcome by Position in Vehicles Involved in Crashes in Maine</i> .....	53
<i>Injury Outcome by Number of People in Cars and Light Trucks Involved in Crashes in Maine</i> .....	53
<i>Injury Outcome By Type of Ejection for Crashes in Maine</i> .....	54
<i>Injury Outcome for Victims of Motor Vehicle Crashes by Seat Belt Use in 1995 in North Dakota</i> .....	54
<i>Injury Outcome for Victims of Motor Vehicle Crashes by Seat Belt Use in 1996 in North Dakota</i> .....	55
<i>Injury Outcome for Victims of Motor Vehicle Crashes by Age Group and Seat Belt Use in 1995 in North Dakota</i> .....	55
<i>Injury Outcome for Victims of Motor Vehicle Crashes by Age Group and Seat Belt Use in 1996 in North Dakota</i> .....	56
<i>Injury Outcome for Victims of Motor Vehicle Crashes by Race and Seat Belt Use in 1995 in North Dakota</i> .....	56

<i>Injury Outcome for Victims of Motor Vehicle Crashes by Race and Seat Belt Use in 1996 in North Dakota</i> .....	57
<i>Injury Outcome for Victims of Motor Vehicle Crashes by Vehicle Seating Position and Seat Belt Use in 1995 in North Dakota</i> .....	57
<i>Injury Outcome for Victims of Motor Vehicle Crashes by Vehicle Seating Position and Seat Belt Use in 1996 in North Dakota</i> .....	58
<i>Injury Outcome for Victims of Motor Vehicle Crashes by Metro/Non-Metro Location of Occurrence and Seat Belt Use in 1995 in North Dakota</i> .....	58
<i>Injury Outcome for Victims of Motor Vehicle Crashes by Metro/Non-Metro Location of Occurrence and Seat Belt Use in 1996 in North Dakota</i> .....	59
<i>Effect of Seating Position and Restraint Use on Injuries to Children in Motor Vehicle Crashes in Utah</i> .....	59
<i>Death and Hospitalization by Belt Use in Wisconsin</i> .....	60
4.3.2 Child Safety Seats .....	60
Studies	
<i>Child Safety Seat Effectiveness in Pennsylvania</i> .....	60
4.3.3 Helmet Utilization .....	61
Studies	
<i>Head Injuries Associated with Motorcycle Use in Wisconsin</i> .....	61
<i>Injuries and Costs Associated with Failure to Use Motorcycle Helmets in Missouri</i> .....	61
4.3.4 Alcohol and Drug Use .....	62
Studies	
<i>Motor Vehicle Crashes Involving Alcohol Impairment in 1995-1996 and Their Outcomes Statewide in Oklahoma</i> .....	62
Management Reports	
<i>Injury Outcome in Alcohol-Related Crashes in Maine</i> .....	62
<i>Injury Outcome for Pedestrians/Bicyclists Involved in Alcohol Related Crashes by Apparent Physical Condition of Driver in Maine</i> .....	63
<i>Injury Outcome by Apparent Physical Condition of Driver in Single Vehicle Crashes in Maine</i> .....	63
4.3.5 Speed	
Studies	
<i>Motor Vehicle Crashes in 1995-1996 by Speed Limit at Crash Site and Their Outcomes Statewide in Oklahoma</i> .....	64

4.3.6 Driver Licensing .....	64
Studies: All Drivers	
<i>Evaluating Drivers Licensed with Medical Conditions in Utah</i> .....	64
Studies: Young Driver	
<i>Comparison of Young and Adult Driver Crashes in Alaska Using Linked</i>	
<i>Traffic Crash and Hospital Data</i> .....	65
<i>Analysis of Crashes Involving Young Adults in Maine</i> .....	65
<i>Motor Vehicle Traffic Crash Outcome Involving Teen Drivers in 1996-1997</i>	
<i>in Nebraska</i> .....	66
<i>Motor Vehicle Crashes Involving Young Drivers (16-17) in 1995-1996 and</i>	
<i>Their Outcomes Statewide in Oklahoma</i> .....	66
<i>A Population-Based Study of Teenage Drivers 1992-1996 in Utah</i> .....	67
<i>Adults and Children in Severe Motor Vehicle Crashes 1992-1995: A</i>	
<i>Matched-Pairs Study in Utah</i> .....	67
Studies: Older Driver	
<i>An Evaluation of Motor Vehicle Crashes Involving Elderly Drivers</i>	
<i>in Connecticut</i> .....	68
<i>Older Drivers: Crashes, Injuries, Outcomes in Maryland</i> .....	68
<i>Hospitalized Driver's Injuries by Age Group: a Focus on Older Drivers</i>	
<i>in New York</i> .....	69
<i>Crashes Involving Older Drivers in New York</i> .....	69
<i>Motor Vehicle Crash Characteristics and Medical Outcomes Among Older</i>	
<i>Drivers 1992-1995 in Utah</i> .....	70
Fact Sheets	
<i>Youth Traffic Safety: Fact Sheet in Alaska</i> .....	70
<i>Young Drivers, Maine Crash Facts, 1996</i> .....	71
<i>Utah Crash Fact Sheet - Graduated Driver Licensing</i> .....	71
4.3.7 Tourists .....	72
Study	
<i>Tourist Collisions in Hawaii</i> .....	72
<b>4.4 Law Enforcement</b> .....	<b>72</b>
4.4.1 Public Education and Planning .....	72
Studies	
<i>Marketing CODES as a Public Education and Planning Tool for Law</i>	
<i>Enforcement in New Hampshire</i> .....	72

## 5.0 APPLICATIONS FOR HIGHWAY SAFETY

### 5.1 Roadway ..... 73

#### 5.1.1 Objects in Roadway ..... 73

##### Studies

*An Evaluation of Severity and Outcome of Injury by Type of Object Struck  
(First Object Struck Only) for Motor Vehicle Crashes in Connecticut* ..... 73

*Modeling the Causes and Consequences of Collisions With Utility Poles  
in Hawaii* ..... 74

*Crashes Involving Collisions With Fixed Objects in New York* ..... 74

*Using Linked Data to Evaluate Crashes Involving Fixed Objects in  
Pennsylvania.* ..... 75

##### Fact Sheets

*Total Occurrences and Total and Average Hospital Charges by Collision  
With Another Object in Iowa* ..... 75

*Fixed Object Crashes: The Top Six by Frequency of Occurrence, the Top  
Six by Average Hospital Charges, and their Geographic Locations  
for Persons Hospitalized As a Result of a Fixed Object Motor Vehicle  
Crash in Iowa.* ..... 76

##### Management Reports

*Injury Outcome for Crashes Involving Moose, Deer or Other/Unknown  
in Maine* ..... 76

#### 5.1.2 Crash Analysis of Roadway ..... 77

##### Studies

*1995 Loudon Road Crash Study for Concord Police Department in  
New Hampshire* ..... 77

*Loudon Road Update of Crash Study for Concord Police Department in  
New Hampshire* ..... 77

## 6.0 APPLICATIONS FOR EMS

### 6.1 Occurrence of EMS Transports ..... 78

##### Studies

*Geographic Information System for Emergency Medical Services Analysis  
in Hawaii* ..... 78

*Characterization of EMS Transports Related to Motor Vehicle  
Crashes in Utah* ..... 79

*Evaluation of Emergency Medical Services: Probabilistic Linkage  
of Computerized Ambulance and Inpatient Hospital Discharge  
Records in Utah* ..... 79

Management Reports	
<i>EMS Response Times by Population Density in Maine</i> .....	80
<i>Severity of Injury and Average on Scene Time for EMS Transports Related to Motor Vehicle Crashes in Maine</i> .....	80

**7.0 GENERAL APPLICATIONS**

**7.1 Standardized Reporting** ..... 81

Study

<i>Standardized Reporting Using CODES in Maine</i> .....	81
<i>Demonstrating a Successful Sequence of Questions to Get the Correct Answer in Utah</i> .....	81

**7.2 Annual Reports** ..... 82

Reports

<i>Missouri Crash Outcome Data Evaluation System (CODES) 1993</i> .....	82
<i>Missouri Crash Outcome Data Evaluation System (CODES) 1996</i> .....	82
<i>Motor Vehicle Crash Outcomes in Nebraska 1996 - Management Reports</i> .....	83
<i>Motor Vehicle Crash Outcomes in Nebraska 1997 - Management Reports</i> .....	83
<i>Utah Crash Summary 1996</i> .....	84

**8.0 APPLICATIONS FOR EVALUATING DATA QUALITY**

**8.1 Under/Over Reporting of Occurrence** ..... 85

Studies

<i>Estimate of Police Under-Reporting of Collisions in Hawaii</i> .....	85
<i>Estimate of Lie Factor for Safety Belt and Alcohol Use in Hawaii</i> .....	85
<i>The Lie Factor in Traffic Safety: Comparison of Police and Hospital Reporting Of Seat Belt and Alcohol Use in Hawaii</i> .....	86
<i>Comparative Reporting of Belt Use, Alcohol, and Type of Injury from Police, EMS, and Hospital Discharge Abstract Reports in Maine</i> .....	86
<i>Unduplication Problem: Multiple Passengers on Buses in Maryland</i> .....	87
<i>Variations in Reported Belt Use in Different State Data Files in Missouri</i> .....	87
<i>Over-Reporting and Measured Effectiveness of Seat Belts in Motor Vehicle Crashes in Utah</i> .....	88
<i>Estimates of the Effects of Seat Belt Over-Reporting on Wisconsin Motor Vehicle Crash Analyses in Wisconsin</i> .....	88

<b>8.2 Errors in Financial Data</b> .....	89
Studies	
<i>Linked Hospital Discharge and Head and Spinal Cord/Trauma Injury Data (HSCIT) to Compare Hospital Charges in Missouri</i> .....	89
<i>The Effects of Data Outliers and Errors in Hospital Charges on Conclusions Regarding the Efficacy of Safety Belt Use in Missouri</i> .....	89
<b>8.3 Developing State Data</b> .....	90
Studies	
<i>Developing Statewide Emergency Department Data in Pennsylvania</i> .....	90
<b>9.0 Applications Related to the Linkage Process</b>	
<b>9.1 Validating the Linkage</b> .....	91
Studies	
<i>Identifying Records That Should Have Linked but Did Not, and Comparing Them to Records That Did Link in Missouri</i> .....	91
<i>Comparing Linkage Methods: Ad Hoc Linkage Versus Probabilistic Linkage in Missouri</i> .....	92
<i>Comparison of Two Hospital Data Files Using the Capture-Recapture Formula in Missouri</i> .....	92
<i>Technical Report on New Mexico CODES Data Linkage</i> .....	93
<i>Probabilistic Record Linkage: Relationships Between File Sizes, Identifiers, and Match Weights in Utah</i> .....	93
<i>Nonfatal Motor Vehicle Crash Injuries: Wisconsin's Experience with Linked Data Systems</i> .....	94

## **1.0 INTRODUCTION**

### **1.1 Purpose of the Catalog**

The purpose of the *Revised Catalog of Types of CODES Applications Implemented Using Linked State Data (CODES)* is to inspire the development of new applications for linked data that support efforts to reduce death, disability, severity, and health care costs related to motor vehicle crashes. The document is divided into three sections. The Introduction describes the purpose of the Catalog, the evolution and components of CODES, and the CODES states. The Background section discusses data resources and case selection, issues related to “as reported” data and the linkage process, and the organization of information included in the catalog. The final section presents abstracts of some of the types of state-specific applications developed or “in process” to date. NHTSA will update the catalog on a periodic basis as the newly funded CODES states develop new applications. This version of the Catalog includes applications developed as of June 2000.

### **1.2 Evolution of CODES**

The Crash Outcome Data Evaluation System (CODES) project evolved from the Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991 which mandated that the National Traffic Safety Administration (NHTSA) report to Congress about the benefits of safety belts and motorcycle helmets in motor vehicle crashes. Benefits were to be measured in terms of reductions in death, disability, and medical costs. Since none of the crash and various injury state data files contains sufficient information to identify the specific crash, vehicle, and behavior characteristics that make a difference to outcome, NHTSA determined that only linked statewide data could provide the necessary outcome information for all persons involved -- those who were injured or who died and those who were not injured. Using these data, comparisons between those using and not using safety belts or motorcycle helmets could be made by identifying and contrasting the characteristics of the injured and uninjured persons within each of the use groups. Also by using state data, the linked data could be used to support state specific purposes and could be disaggregated to support safety efforts at the local and regional levels.

### **1.3 A Description of CODES**

CODES consists of linked statewide crash and injury data that match vehicle, crash, and human behavior characteristics to their specific medical and financial outcomes. These state data are located in multiple sources: crash data collected by police at the scene; EMS data collected by EMTs who provide treatment at the scene and enroute; medical data collected by physicians, nurses and others who provide treatment at the emergency department, in the hospital, or outpatient setting; and third party payors who pay. Linkage enables persons involved in the motor vehicle crash to be traced from the scene to their final medical and financial outcomes. To implement CODES, states, as a minimum, need computerized statewide crash, hospital, and EMS or emergency department data that have sufficient information to discriminate among the crash events and persons involved in each event. When these data are also linked to driver licensing, vehicle registration, citation/conviction records, insurance claims, HMO/managed care/etc. outpatient records, etc., the linked data are more comprehensive and thus even more useful for



state specific purposes. Although state data are frequently imperfect, linkage is feasible using a probabilistic linkage technology that identifies valid matches without requiring exact matches among the attribute values. This technology makes it possible to process a phenomenal amount of data in a short amount of time. Successful implementation of CODES depends upon a Board of Directors consisting of the data owners who collaboratively resolve issues related to data access, patient confidentiality, management and release of the linked data and institutionalization of CODES. A CODES Advisory Committee consisting of both the data owners and users develops and monitors applications of the linked data. An added benefit of data linkage is that data quality improves when missing and inaccurate data highlighted during the linkage process are corrected.

### 1.4 Implementation of CODES

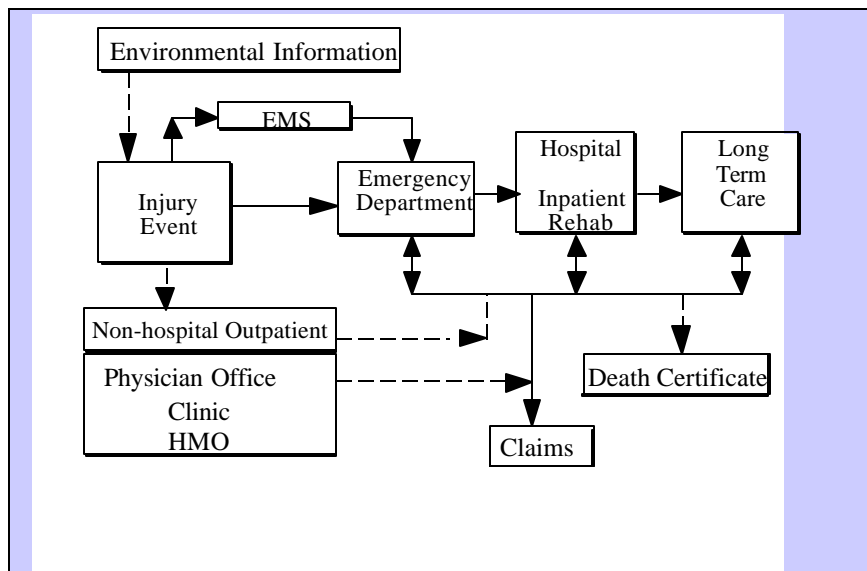


Exhibit 1

NHTSA funded Hawaii, Maine, Missouri, New York, Pennsylvania, Utah, and Wisconsin to implement Crash Outcome Data Evaluation Systems (CODES) to generate linked state crash and injury data for the Report to Congress and for state specific purposes. Statewide police reported crash reports were linked to emergency medical services, emergency department, hospital discharge, rehabilitation, long term care, death certificate and/or claims data as shown in Exhibit 1. Each CODES state's linked data base varies in terms of the data files linked but all of them include at least 12 months of person-specific, population-based, statewide data that permit tracking of persons involved in motor vehicle crashes from the scene to final disposition. Each state controls access to its linked data. To encourage the development of new applications for linked data, NHTSA funded three of the CODES states (New York, Pennsylvania, Wisconsin) and three other states (Alaska, Connecticut, and New Mexico) to use their existing linked state data to develop additional state-specific applications. To encourage the development of data linkage capabilities in all states nationally, NHTSA funded Connecticut, Maryland, Nevada, New Hampshire, North Dakota, Oklahoma, South Dakota in 1997; Iowa, Kentucky, Massachusetts, Nebraska and South Carolina in 1998; and Arizona, Delaware, Minnesota and Tennessee in 1999. Additional states will be funded in 2000.

## 2.0 BACKGROUND

### 2.1. Data Resources and Case Selection

For computerized data files to be linked, they must exist. Unfortunately, not all states have crash and injury data that are statewide and computerized. Almost all of the states have computerized crash data statewide. Half of the states have developed state EMS data systems, but less have statewide emergency department data systems. A majority of the states have computerized state hospital discharge data systems. All of the states have computerized Medicaid and Medicare data systems, but few states have statewide computerized data files for private vehicle or health insurance claims data. Access to data for the less seriously injured victims, a group that includes many of the successes for highway safety, is difficult to obtain because the data may not be computerized. Or if computerized, they are computerized by provider or by insurance group and rarely statewide. Injury data are particularly useful to highway safety because they document what happens to all victims injured in motor vehicle crashes, regardless of whether the crash itself meets police reporting thresholds.

More information about the experience of the seven original CODES states performing the data linkage may be obtained from the *Technical Report: Crash Outcome Data Evaluation System Project* published by NHTSA. Table 1 below presents the study populations that can be generated from the linkage of different groups of state data files.

<b>Table 1: Populations Generated by Groups of Linked Data</b>				
<b>Crash Data Linked to:</b>	<b>Hospitalized</b>	<b>Transported by EMS</b>	<b>Treated in ED Regardless of EMS Transport</b>	<b>Treated as Outpatient at Physician's Office</b>
Hospital	X			
EMS, Hospital	X	X		
EMS, ED, Hosp.	X	X	X	
Medicare /Medicaid Insurance	X	X	X	X

### 2.2 Issues Related to “As Reported” Data and the Linkage Process

The usefulness of existing computerized state data collected for other purposes and then linked to fulfill highway safety data needs depends upon the quality of “as reported” state data. The user must understand what and how the state data are collected since data quality reflects the environment of the crash and the existence of legislative mandates. The following issues must be considered when developing applications for linked crash and injury state data.

**2.2.1 Utilization of Safety Measures:** Crash data document the events of a crash including utilization information to support police enforcement activities related to safety devices. Over or under reporting of utilization may be related to the existence and enforcement of laws and insurance regulations mandating their use, or non-use in the case of alcohol. For example, when a state penalizes occupants who fail to buckle up, the unbelted occupant involved in a crash may be tempted to report belt use, particularly when the crash or injury is minor. Thus, “as reported” data alone may inflate the calculations of effectiveness. Combining “as reported” with observed or linked data is likely to generate more realistic rates.

**2.2.2 Defining an Injury:** Injury data include medical information about the occurrence of injuries and their costs. Without linkage to the crash data, victims injured in a motor vehicle crash can be identified in the injury data only when the medical record documents the external cause of injury (motor vehicle crash, fall, etc.), for example by an E-code. Use of the E-code is useful to identify records for injuries caused by a motor vehicle crash that failed to link to a crash report or were not reportable because the crash occurred on a non-public road. Thus, use of both crash and injury data together is more likely to identify more injuries resulting from motor vehicle crashes than use of the crash or injury data alone.

**2.2.3 Identifying the Type of Injury:** Documentation of the type of injury varies in the different state data files. Non-medical data sources, such as the crash report, may document the area and type of injury in general terms such as head, neck, bleeding and broken bone. Injury severity in this type of data is documented in functional terms to indicate the need for help from the scene (killed, incapacitated, non-incapacitated, possible, none). Medical data sources use more specific terms. EMS data indicate specific types and areas of injury augmented by information describing the treatment provided and record injury severity using the patient’s vital signs. Hospital data document the area and type of injury using medical terms coded according to the International Classification of Diseases, 9th edition, Clinical Modifications (ICD-9-CM). Injury severity is then defined in anatomical terms based on the ICD-9-CM codes. Thus, a group of head injured patients selected from the crash data is likely to include non-head injuries compared to a group of head injured patients selected from the more precise hospital data.

**2.2.4 Identifying Costs and Charges:** Injury data document the total charges associated with providing medical care to a specific patient but do not document the actual cost of providing care or the actual revenue received by the provider of the care for that specific patient. Charge information is recorded for patients discharged from an acute care hospital. Sometimes this information is also available from billing records for patients transported by EMS or treated in the emergency department. It is important to note that total charges represent the “price” charged for treatment. Charge information documented in EMS, emergency department, and hospital data systems may not include charges by private physicians who are not on the staff of the facility/agency where the patient is treated. Charge information also does not include the indirect costs, such as loss of productivity or long term care and social support, incurred by those suffering long term disability. The bottom line is that total charges are commonly used to report “costs” of health care. However, the user must remember that the charge information that is available understates the total

expenses incurred as the result of motor vehicle crashes.

**2.2.5 The Linkage Process:** Some measures, such as effectiveness rates for countermeasures, are not affected by the linkage process unless the false negative rate (records for injured victims that should have linked but did not) and/or the false positive rate (records for non-injured victims that linked but should not have) are high enough to cause the injured and uninjured populations to be misrepresented. These rates may cause totals, such as total EMS transports, hospitalizations, charges, and hospital days, to be incorrect. In addition, average charges may be understated if failure to link records contain injured persons with unusually high hospital charges and long lengths of stay or overstated if a false positive linkage included a hospital record with unusually high hospital charges and long lengths of stay.

Records with more discriminating information about the events and persons involved are more likely to match than records with less information. For example, date of birth is frequently available on the crash report only for drivers. Without the capability to obtain date of birth for non-drivers through ancillary linkages, injury records for drivers are more likely to link than those for non-drivers. The potential for systematic biases to occur can be estimated by reviewing the reporting thresholds, variations in submission and data quality rates by police agency, provider, or geographic service area to ensure that specific population groups, types of services, etc. are not under- or over-reported for either the injured or uninjured.

Thus, before performing any analyses, the accuracy and completeness of the linked data must be evaluated relative to the type of study population and the outcome measures used for the study.

## **2.3 Organization of the Catalog**

This catalog presents some of the types of state specific applications developed or in process to date by the CODES states. The applications published in this version reflect how the linked state data are being used to support state-specific efforts. The types of applications are listed under one of seven subject areas: Injury Prevention, Traffic Safety, Highway Safety, EMS, General Applications, Data Quality, and Linkage Process. Within each subject area, the applications are categorized by topic area. Exhibit 2 presents the topic areas included within each subject area. Within each topic area, the applications are sorted by type (study, fact sheet, management report) and listed alphabetically by state. A study presents research information in a narrative format. A fact sheet presents information using bullet statements, charts and limited narrative. A management report presents data in rows and columns.

Exhibit 2: Classification of State Specific APPLICATIONS for Linked Data by Subject Area and Topic	
Subject Area	Topic Areas
3.0 Injury Prevention	3.1 Occurrence of Injury 3.2 Health Care Costs
4.0 Traffic Safety	4.1 Crash Characteristics 4.2 Vehicle Characteristics 4.3 Person Characteristics 4.4 Law Enforcement
5.0 Highway Safety	5.1 Roadway
6.0 EMS	6.1 EMS Transports
7.0 General Applications	7.1 Standardized Reporting 7.2 Annual Reports
8.0 Data Quality	8.1 Under/Over Reporting of Occurrences 8.2 Errors in Financial Information 8.3 Developing State Data
9.0 Linkage Process	9.1 Validating the Linkage

Information describing each state specific application is presented using the following format:

*(Title and Authors)*

Scope	(time period and definition of study population)
Data Used	(names of state data files linked for the application)
Format	(indication that application is a study, fact sheet, management report, report )
Description	(summary of the methodology and types of information used to generate the application)
Contact Person	(person to contact for more information about the application)

Copies of the studies, fact sheets, management reports or reports presented in this catalog may be obtained directly from the contact person listed for each application.

### 3.0 APPLICATIONS FOR INJURY PREVENTION

#### 3.1 Evaluating the Occurrence of Injury

##### 3.1.1 By Age

##### Management Reports

*Total Victims and Total Hospital Charges by Restraint Used, Type of Crash, and Injury Severity Level(KABCO) for Children (12-17 years) Injured in Motor Vehicle Crashes in New Hampshire.*

Thomas Hettinger

Scope	All Children 12-17 years of age Injured in Motor Vehicle Crashes in New Hampshire in 1996.
Data Used	Crash data linked to hospital discharge data.
Format	Management Report
Description	This management report presents in two parts the total victims and total hospital charges for children (12-17 years of age) injured in motor vehicle crashes. The total victims and hospital charge information is presented by type of restraint system used, type of crash, and injury severity level (KABCO).
Contact Person	Thomas Hettinger TEL: 603.271.0322; FAX: 603.271.4567 email: hetcon@mediaone.net

*Injury Rates and Outcome for Males by Age in 1995 Crashes in Maine*

Maine CODES Board of Directors

Scope	All males involved in 1995 motor vehicle crashes statewide in Maine
Data Used	Crash linked to EMS, hospital and census data
Format	Management Report
Description	This management report presents total male population, total male persons involved, total males injured, and the injury rate per 100,000 males. For those males injured, it presents the total transported by EMS, hospitalized, hospital days, hospital charges, head injury, fatalities, and years of potential life lost. Data are reported by age groups.
Contact Person	Cathy St. Pierre TEL: 207-624-5467; FAX: 207-624-5470 email: cathy.s.stpierre@state.me.us

3.1.1 Age

*Injury Rates and Outcome for Females by Age in 1995 Crashes in Maine*  
 Maine CODES Board of Directors

Scope	All females involved in 1995 motor vehicle crashes statewide in Maine
Data Used	Crash linked to EMS, hospital and census data
Format	Management Report
Description	This management report presents total female population, total female persons involved, total females injured, and the injury rate per 100,000 females. For those females injured, it presents the total transported by EMS, hospitalized, hospital days, hospital charges, head injury, fatals, and years of potential life lost. Data are reported by age groups.
Contact Person	Cathy St. Pierre TEL: 207.624.5467; FAX: 207.624.5470 email: cathy.s.stpierre@state.me.us

**3.1.2 Involving Pedestrians**

**Fact Sheets**

*1998 Utah Crash Facts - Pedestrians*  
 Amy Lightfoot

Scope	All pedestrians and drivers involved in a pedestrian-related crash statewide in 1998 in Utah
Data Used	Crash linked to hospital discharge and emergency department data.
Format	Fact Sheet
Description	This fact sheet describes the who, what, when, where, and how of pedestrian-related motor vehicle crashes. Highlights include: inpatient and emergency department charges incurred by injured pedestrians; ages and gender of pedestrians and drivers; contributing factors and violations of drivers; time of day, day of week, and month of year pedestrian crashes occurred; and trend data from 1992-1998 for the number of pedestrian crashes, pedestrian injury crashes, and fatal pedestrian crashes.
Contact Person	Janet Almond TEL: 801.585.6410 FAX: 801.581.8686 email: janet.almond@hsc.utah.edu

3.1.2 Pedestrians

## Management Reports

### *Injury Outcome by Age Group for Male Pedestrians in 1996 Crashes in Maine*

Maine CODES Board of Directors

Scope	All persons involved in 1996 motor vehicle crashes statewide in Maine
Data Used	Crash linked to EMS, hospital and census data
Format	Management Report
Description	This management report presents injury outcome for male pedestrians including total male population, total male pedestrians involved, total injured and injury rate per 100,000, total transported by EMS, total admitted to a hospital, total hospital days and charges, total with head injury, total deaths and total years of potential life lost. Data are reported by age groups.
Contact Person	Cathy St. Pierre TEL: 207.624.5467; FAX: 207.624.5470 email: cathy.s.stpierre@state.me.us

### *Injury Outcome by Age Group for Female Pedestrians in 1996 Crashes in Maine*

Maine CODES Board of Directors

Scope	All persons involved in 1996 motor vehicle crashes statewide in Maine
Data Used	Crash linked to EMS, hospital and census data
Format	Management Report
Description	This management report presents injury outcome for female pedestrians including total female population, total female pedestrians involved, total injured and injury rate per 100,000, total transported by EMS, total admitted to a hospital, total hospital days and charges, total with head injury, total deaths and total years of potential life lost. Data are reported by age groups.
Contact Person	Cathy St. Pierre TEL: 207.624.5467; FAX: 207.624.5470 email: cathy.s.stpierre@state.me.us



*Injury Outcome by County of Crash Location for Pedestrians Involved in 1996 Crashes in Maine*  
 Maine CODES Board of Directors

Scope	All persons involved in 1996 motor vehicle crashes statewide in Maine
Data Used	Crash linked to EMS, hospital and census data
Format	Management Report
Description	This management report presents injury outcome by county of crash including total population, total pedestrians involved, total injured and injury rate per 100,000, total transported by EMS, total admitted to a hospital, total hospital days and charges, total with head injury, total deaths and total years of potential life lost. Data are reported for each of the 16 counties in Maine.
Contact Person	Cathy St. Pierre TEL: 207.624.5467; FAX: 207.624.5470 email: cathy.s.stpierre@state.me.us

*Injury Outcome by Month of Crash for Pedestrians in Crashes in Maine*  
 Karl Finison and Gary Menchen

Scope	All persons involved in 1991 motor vehicle crashes statewide in Maine
Data Used	Crash linked to EMS, hospital and census data
Format	Management Report
Description	This management report presents the injury outcome by month of the crash for pedestrians involved in crashes including the total involved, total injured, injury rate per 100,000, total transported by EMS, total admitted to a hospital, total with severe injury ISS>15, total charges, total with head/spinal injuries, total deaths and total years of potential life lost.
Contact Person	Karl Finison TEL: 207.623.2555; FAX: 207.622.7086 email: kfinison@mhic.org

*Injury Outcome by Day of Week of Crash for Pedestrians in Crashes in Maine*  
 Karl Finison and Gary Menchen

Scope	All persons involved in 1991 motor vehicle crashes statewide in Maine
Data Used	Crash linked to EMS, hospital and census data
Format	Management Report
Description	This management report presents the injury outcome by day of week of the crash for pedestrians involved in crashes including the total involved, total injured, injury rate per 100,000, total transported by EMS, total admitted to a hospital, total with severe injury ISS>15, total charges, total with head/spinal injuries, total deaths and total years of potential life lost.
Contact Person	Karl Finison TEL: 207.623.2555; FAX: 207.622.7086 email: kfinison@mhic.org

*Injury Outcome by Time of Crash (1 hour intervals) for Pedestrians in Crashes in Maine*  
 Karl Finison and Gary Menchen.

Scope	All persons involved in 1991 motor vehicle crashes statewide in Maine
Data Used	Crash linked to EMS, hospital and census data
Format	Management Report
Description	This management report presents by time of the crash, using one hour intervals, for pedestrians involved in crashes the injury outcome including the total involved, total injured, injury rate per 100,000, total transported by EMS, total admitted to a hospital, total with severe injury ISS>15, total charges, total with head/spinal injuries, total deaths and total years of potential life lost.
Contact Person	Karl Finison TEL: 207.623.2555; FAX: 207.622.7086 email: kfinison@mhic.org

*Injury Outcome for Pedestrians Involved in Alcohol-Related Crashes in Maine*  
Karl Finison and Gary Menchen.

Scope	All persons involved in 1991 motor vehicle crashes statewide in Maine
Data Used	Crash linked to EMS, hospital and census data
Format	Management Report
Description	This management report presents injury outcome for pedestrians involved in alcohol and non alcohol-related crashes including the total involved, total injured, total transported by EMS, total admitted to a hospital, total with severe injury ISS>15, total charges, total with head/spinal injuries, total deaths, total years of potential life lost, and relative risk.
Contact Person	Karl Finison TEL: 207.623.2555; FAX: 207.622.7086 email: kfinison@mhic.org

*Injury Outcome for Pedestrians Involved in Motor Vehicle Crashes by Population Density of Crash Location in Maine*  
Karl Finison and Gary Menchen.

Scope	All persons involved in 1991 motor vehicle crashes statewide in Maine
Data Used	Crash linked to EMS, hospital and census data
Format	Management Report
Description	This management report presents for pedestrians involved in motor vehicle crashes by population density of crash location, the injury outcome including the total involved, total injured, total transported by EMS, total admitted to a hospital, total with severe injury ISS>15, total charges, total with head/spinal injuries, total deaths, total years of potential life lost, and relative risk of injury. Crash location is defined as population per square mile as follows: metro (>500), urban (101-500), Suburban (51-100), rural (7-50), wilderness (<7), unknown.
Contact Person	Karl Finison TEL: 207.623.2555; FAX: 207.622.7086 email: kfinison@mhic.org

3.1.2 Pedestrians

*Injury Outcome for Pedestrians Involved in Crashes by Roadway Location of Crash in Maine*  
Karl Finison and Gary Menchen

Scope	All persons involved in 1991 motor vehicle crashes statewide in Maine
Data Used	Crash linked to EMS, hospital and census data
Format	Management Report
Description	This management report presents for pedestrians involved in crashes by roadway location of crash the total involved, total injured, percent of total injured, total transported by EMS, total admitted to a hospital, total with severe injury ISS>15, total charges, total with head/spinal injuries, total deaths, years of potential life lost and the relative risk. Location of crash is defined as straight road, curved, 3 legged intersection, 4 legged intersection, 5 legged intersection, driveways, bridges, interchange, other, missing/invalid.
Contact Person	Karl Finison TEL: 207.623.2555; FAX: 207.622.7086 email: kfinison@mhic.org

*Injury Outcome for Pedestrians Involved in Motor Vehicle Crashes by Apparent Contributing Factor in Maine*

Karl Finison and Gary Menchen

Scope	All persons involved in 1991 motor vehicle crashes statewide in Maine
Data Used	Crash linked to EMS, hospital and census data
Format	Management Report
Description	This management report presents for pedestrians involved in motor vehicle crashes by apparent contributing factor in single vehicle crashes, the total involved, total injured, percent of total injured, total transported by EMS, total admitted to a hospital, total with severe injury ISS>15, total charges, total with head/spinal injuries, total deaths and years of potential life lost. Results are shown separately for thirty different apparent contributing factors.
Contact Person	Karl Finison TEL: 207.623.2555; FAX: 207.622.7086 email: kfinison@mhic.org

3.1.2 Pedestrians

### 3.1.3 Involving Bicyclists

#### Management Reports

*Injury Outcome by Age Group for Male Bicyclists Involved in 1996 Crashes in Maine*  
Maine CODES Board of Directors

Scope	All persons involved in 1996 motor vehicle crashes statewide in Maine
Data Used	Crash linked to EMS, hospital and census data
Format	Management Report
Description	This management report presents injury outcome for male bicyclists including total male population, total male bicyclists involved, total injured and injury rate per 100,000, total transported by EMS, total admitted to a hospital, total hospital days and charges, total with head injury, total deaths and total years of potential life lost. Data are reported by age groups.
Contact Person	Cathy St. Pierre TEL: 207.624.5467; FAX: 207.624.5470 email: cathy.s.stpierre@state.me.us

*Injury Outcome by Age Group for Female Bicyclists Involved in 1996 Crashes in Maine*  
Maine CODES Board of Directors

Scope	All persons involved in 1996 motor vehicle crashes statewide in Maine
Data Used	Crash linked to EMS, hospital and census data
Format	Management Report
Description	This management report presents injury outcome for female bicyclists including total female population, total female bicyclists involved, total injured and injury rate per 100,000, total transported by EMS, total admitted to a hospital, total hospital days and charges, total with head injury, total deaths and total years of potential life lost. Data are reported by age groups.
Contact Person	Cathy St. Pierre TEL: 207.624.5467; FAX: 207.624.5470 email: cathy.s.stpierre@state.me.us

*Injury Outcome by County of Crash Location for Bicyclists Involved in 1996 Crashes in Maine*  
 Maine CODES Board of Directors

Scope	All persons involved in 1996 motor vehicle crashes statewide in Maine
Data Used	Crash linked to EMS, hospital and census data
Format	Management Report
Description	This management report presents injury outcome by county of crash including total population, total bicyclists involved, total injured and injury rate per 100,000, total transported by EMS, total admitted to a hospital, total hospital days and charges, total with head injury, total deaths and total years of potential life lost. Data are reported for each of the 16 counties in Maine.
Contact Person	Cathy St. Pierre TEL: 207.624.5467; FAX: 207.624.5470 email: cathy.s.stpierre@state.me.us

*Injury Outcome by Month of Crash for Bicyclists Involved in Crashes in Maine*  
 Karl Finison and Gary Menchen.

Scope	All persons involved in 1991 motor vehicle crashes statewide in Maine
Data Used	Crash linked to EMS, hospital and census data
Format	Management Report
Description	This management report presents for bicyclists involved in crashes the injury outcome by month of crash for pedestrians including the total involved, total injured, injury rate per 100,000, total transported by EMS, total admitted to a hospital, total with severe injury ISS>15, total charges, total with head/spinal injuries, total deaths and total years of potential life lost.
Contact Person	Karl Finison TEL: 207.623.2555; FAX: 207.622.7086 email: kfinison@mhic.org

*Injury Outcome by Day of Week of Crash for Bicyclists Involved in Crashes in Maine*  
Karl Finison and Gary Menchen.

Scope	All persons involved in 1991 motor vehicle crashes statewide in Maine
Data Used	Crash linked to EMS, hospital and census data
Format	Management Report
Description	This management report presents by day of week for bicyclists involved in crashes the injury outcome including the total involved, total injured, injury rate per 100,000, total transported by EMS, total admitted to a hospital, total with severe injury ISS>15, total charges, total with head/spinal injuries, total deaths and total years of potential life lost.
Contact Person	Karl Finison TEL: 207.623.2555; FAX: 207.622.7086 email: kfinison@mhic.org

*Injury Outcome by Time of Crash (1 hour intervals) for Bicyclists Involved in Crashes in Maine*  
Karl Finison and Gary Menchen.

Scope	All persons involved in 1991 motor vehicle crashes statewide in Maine
Data Used	Crash linked to EMS, hospital and census data
Format	Management Report
Description	This management report presents for bicyclists involved in crashes by time of crash using one hour intervals the injury outcome including the total involved, total injured, injury rate per 100,000, total transported by EMS, total admitted to a hospital, total with severe injury ISS>15, total charges, total with head/spinal injuries, total deaths and total years of potential life lost.
Contact Person	Karl Finison TEL: 207.623.2555; FAX: 207.622.7086 email: kfinison@mhic.org

*Injury Outcome for Bicyclists Involved in Alcohol-Related Crashes in Maine*  
Karl Finison and Gary Menchen.

Scope	All persons involved in 1991 motor vehicle crashes statewide in Maine
Data Used	Crash linked to EMS, hospital and census data
Format	Management Report
Description	This management report presents injury outcome for bicyclists including the total involved, total injured, total transported by EMS, total admitted to a hospital, total with severe injury ISS>15, total charges, total with head/spinal injuries, total deaths, total years of potential life lost, and relative risk. Data are reported separately for alcohol involved and non-alcohol involved crashes.
Contact Person	Karl Finison TEL: 207.623.2555; FAX: 207.622.7086 email: kfinison@mhic.org

*Injury Outcome for Bicyclists Involved in Motor Vehicle Crashes by Population Density of Crash Location in Maine*  
Karl Finison and Gary Menchen.

Scope	All persons involved in 1991 motor vehicle crashes statewide in Maine
Data Used	Crash linked to EMS, hospital and census data
Format	Management Report
Description	This management report presents for bicyclists involved in motor vehicle crashes by population density of crash location, the injury outcome including the total involved, total injured, total transported by EMS, total admitted to a hospital, total with severe injury ISS>15, total charges, total with head/spinal injuries, total deaths, total years of potential life lost, and relative risk of injury. Crash location is defined as population per square mile as follows: metro (>500), urban (101-500), Suburban (51-100), rural (7-50), wilderness (<7), unknown.
Contact Person	Karl Finison TEL: 207.623.2555; FAX: 207.622.7086 email: kfinison@mhic.org



*Injury Outcome for Bicyclists Involved in Crashes by Roadway Location of Crash in Maine*  
Karl Finison and Gary Menchen

Scope	All persons involved in 1991 motor vehicle crashes statewide in Maine
Data Used	Crash linked to EMS, hospital and census data
Format	Management Report
Description	This management report presents for bicyclists involved in crashes by roadway location of crash the total involved, total injured, percent of total injured, total transported by EMS, total admitted to a hospital, total with severe injury ISS>15, total charges, total with head/spinal injuries, total deaths, years of potential life lost and the relative risk. Roadway location is defined as straight road, curved, 3 legged intersection, 4 legged intersection, 5 legged intersection, driveways, bridges, interchange, other, missing/invalid.
Contact Person	Karl Finison TEL: 207.623.2555; FAX: 207.622.7086 email: kfinison@mhic.org

*Injury Outcome for Bicyclists Involved in Motor Vehicle Crashes by Apparent Contributing Factor in Maine*

Karl Finison and Gary Menchen

Scope	All persons involved in 1991 motor vehicle crashes statewide in Maine
Data Used	Crash linked to EMS, hospital and census data
Format	Management Report
Description	This management report presents for bicyclists involved in motor vehicle crashes by apparent contributing factor the total involved, total injured, percent of total injured, total transported by EMS, total admitted to a hospital, total with severe injury ISS>15, total charges, total with head/spinal injuries, total deaths and years of potential life lost. Results are shown separately for thirty different apparent contributing factors.
Contact Person	Karl Finison TEL: 207.623.2555; FAX: 207.622.7086 email: kfinison@mhic.org

3.1.3 Bicyclists

### 3.1.4 Involving Motorcyclists

#### Study

##### *Statewide Study of Injured Motorcyclists in Maryland*

Patricia C. Dischinger, Shiu M. Ho, Joseph A. Kufera

Scope	All motorcyclists hospitalized or killed following a motorcycle crash in Maryland for the years 1995-1996
Data Used	Crash report linked to hospital discharge record, and medical examiner's data
Format	Study
Description	This comprehensive study of injuries due to motorcycle crashes in the State of Maryland focuses on whether or not the motorcyclist was helmeted at the time of the injury. The nature and severity of injuries, as well as the lengths of stay in the hospital, are described for those with and without helmets. Costs are computed for motorcyclists with and without helmets. In addition, an analysis of payer type is included.
Contact person	Patricia C. Dischinger TEL: 410.328.4246; FAX: 410.328.3699 email: pdischin@nsc.ummc.umaryland.edu

#### Management Report

##### *Injury Outcome by Age Group for Motorcyclists Involved in 1996 Crashes in Maine*

Maine CODES Board of Directors

Scope	All persons involved in 1996 motor vehicle crashes statewide in Maine
Data Used	Crash linked to EMS, hospital and census data
Format	Management Report
Description	This management report presents injury outcome by age group for motorcyclists including total registered motorcyclists, total motorcycle crashes, crash rate per 100,000 drivers, total persons involved, total injured and injury rate per 100,000 drivers, total transported by EMS, total admitted to a hospital, total hospital days and charges, total with head injury, total deaths and total years of potential life lost.
Contact Person	Cathy St. Pierre TEL: 207.624.5467; FAX: 207.624.5470 email: cathy.s.stpierre@state.me.us

3.1.4 Motorcyclists

### 3.1.5 By Geographic Location

#### Studies

*Analysis of Medical and Financial Outcomes of Motor Vehicle Crash/Injuries in Connecticut.*

Gerald Zuckier, Lenworth Jacobs, Lorna Thibeault

Scope	All persons involved in 1995 crashes in Connecticut
Data Used	Crash data linked to emergency department, ambulatory surgery, hospital discharge, death certificate data.
Format	Study
Description	This study uses multiple logistic regression with backward stepwise selection and outcome defined as the frequency of severe injury (killed or incapacitating), severity of injury, mortality, length of stay, discharge disposition, and total hospital charges. Age is categorized into 5 sub-groups and length of stay into three groups. Mortality is categorized in terms of place of death (scene, ED, hospital, after discharge). Type of injury is defined according to KABCO. Independent variables include age, gender, location of the crash, location of fixed object struck, speeding, following too closely, violating traffic controls, unsafe use of highway by pedestrian, driver illness, construction, road surface, snow, rain, drinking status of driver and lighting conditions, type of motor vehicle, collision type, and injury classification. Data are linked using a deterministic algorithm.
Contact Person	Gerald Zuckier TEL: 203.294.7354; FAX: 203.284.9318 email: zuckier@chime.org

*Linked Data and GIS Using an Access Data Base in Connecticut.*

Ellen Cromley

Scope	All persons involved in 1995 crashes in Connecticut
Data Used	Crash data linked to emergency department, ambulatory surgery, hospital discharge, death certificate data.
Format	Study
Description	A table of crash identification numbers are passed from Access to the geographic information system to generate both a tabular and geographic view of the linked data. Although Access can produce more detailed reports, the combination of Access and GIS provides detailed information about the crashes of interest and their location plus the places of interest and what type of crashes occur there.
Contact Person	Mary Kapp TEL: 860.509.7799; FAX: 860.509.7854 email: kapp@po.state.ct.us

3.1.5 Location

*1996 Motor Vehicle Crash Injuries and Hospital Charges in Rural and Urban Areas in Nebraska*  
Ming Qu and Dan Christensen

Scope	All persons involved in motor vehicle crashes in Nebraska in 1996
Data Used	Crash linked to EMS and inpatient hospital discharge data
Format	Study
Description	This study compares motor vehicle-related deaths, injuries, and hospital charges in urban and rural areas in the state. A descriptive analysis examines age, gender, alcohol involvement, occupant protection, and several crash factors. The crash factors include crash type, roadway type, vehicle type, posted speed limits, and the month the crash occurred. EMS response time is compared for rural and urban areas. The outcome measures evaluate injury severity and hospital charges. Recommendations regarding data quality are discussed.
Contact Person	Ming Qu TEL: 402.471.0566; FAX: 402.471.6436 email: ming.qu@hss.state.ne.us

*Issues Surrounding GIS Issues and Traffic Crashes in South Carolina*  
Mary Pease and Tracy Joyce

Scope	All traffic collisions occurring in South Carolina.
Data Used	Geo-coded crash location data linked to EMS, ED and hospital discharge data
Format	Study
Description	This presentation displays crash data mapped to the approximate locations for South Carolina, using a geocoding methodology specifically for the crash report linked data files. It describes the details of problems encountered and suggested strategies for overcoming such problems. Recommendations to other involved agencies regarding GIS mapping using linked data are suggested with the realization that the recommendations may contradict current GIS technology.
Contact Person	Mary Pease TEL: 803.898.9955; FAX: 803.898.9972 email: mpease@ors.state.sc.us

3.1.5 Location

*Using Linked Data to Support Safe Communities in South Dakota (in process)*

Kareen Dougherty

Scope	All persons less than 25 years of age involved in vehicle crashes statewide in South Dakota
Data Used	Crash linked to inpatient hospital discharge data and death certificate data.
Format	Study
Description	The CODES linked data will be used in conjunction with death certificate data to demonstrate the significance of motor vehicle crashes in relation to other injury causes. This study will provide statistical and cost information by cause of death and age group (<1 year, 1-4, 5-9, 10-14, 15-19, 20-24).
Contact Person	Kareen Dougherty TEL: 605.367.5252; FAX: 605.677.5427 email: kdougher@charlie.usd.edu

*Observing if the Safe Communities Are “Getting It” in Wisconsin.*

Wayne Bigelow

Scope	All persons involved in 1992-1997 crashes in Wisconsin
Data Used	Crash data linked to inpatient hospital discharge data.
Format	Study
Description	This study reports how CODES linked data generate community-resident specific reports to support Safe Communities. CODES linked data answer questions related to frequencies and changes over time, comparisons, severity, costs, morbidity and mortality trends. Over 200 reports have been generated and distributed since 1997. New reports will include specific information for teenagers, age breakdowns for injuries and deaths.
Contact Person	Martha Florey TEL: 608.266.3557; FAX: 608.267.0441 email: mflorey@mail.state.wi.us

3.1.5 Location

## Management Reports

### *Injury Outcome by County of Crash Location in Maine*

Maine CODES Board of Directors

Scope	All persons involved in 1995 motor vehicle crashes statewide in Maine
Data Used	Crash linked to EMS, hospital and census data
Format	Management Report
Description	This management report presents by county in Maine, the population, the total number of crashes, total vehicles involved, total persons involved, total injured, injury rate per 100,000, total transported by EMS, total hospitalized, total hospital days, total hospital charges, total with head injury, total fatalities, and years of potential life lost. Data are reported for the 16 counties in Maine.
Contact Person	Cathy St. Pierre TEL: 207.624.5467; FAX: 207.624.5470 email: cathy.s.stpierre@state.me.us

### *Injury Outcome by Hospital Service Area in Maine*

Karl Finison and Gary Menchen

Scope	All persons involved in 1991 motor vehicle crashes statewide in Maine
Data Used	Crash linked to EMS, hospital and census data
Format	Management Report
Description	This management report presents by hospital service area in Maine, the total occupants, total injured, injury rate per 100,000 population, total transported by EMS, total admitted to a hospital, total with severe injury ISS>15, total charges, total with head/spinal injuries, total deaths, and the years of potential life lost. Data are reported for 32 hospital service areas within Maine.
Contact Person	Karl Finison TEL: 207.623.2555; FAX: 207.622.7086 email: kfinison@mhic.org

*Injury Outcome by Population Density of Crash Location in Maine*

Karl Finison and Gary Menchen

Scope	All persons involved in 1991 motor vehicle crashes statewide in Maine
Data Used	Crash linked to EMS, hospital and census data
Format	Management Report
Description	This management report presents by population density of the crash location in Maine, the total occupants, total injured, percent of total injuries, total transported by EMS, total admitted to a hospital, total with severe injury ISS>15, total charges, total with head/spinal injuries, total deaths, and the years of potential life lost and the relative risk. Crash location is defined as population per square mile as follows: metro (>500), urban (101-500), Suburban (51-100), rural (7-50), wilderness (<7), unknown.
Contact Person	Karl Finison TEL: 207.623.2555; FAX: 207.622.7086 email: kfinison@mhic.org

*Injury Rates and Outcomes by Safe Community Area in South Carolina*

Mary Pease and Tracy Joyce

Scope	All injuries as a result of crashes during 1998-1999 in Safe Community areas
Data Used	Crash linked to EMS, hospital and census data
Format	Management Report
Description	This management report presents a community profile including injuries and injury outcomes for drivers, occupants, pedestrians and bicyclists by age and sex; crash location; residence of drivers; date and time; total injured; injury rate per 100,000; total head/spinal injuries; total charges; total cost; cost and charges by payer; average charges per restraint type.
Contact Person	Mary Pease TEL: 803.898.9955; FAX: 803.898.9972 email: mpease@ors.state.sc.us

3.1.5 Location

### 3.1.6 By Date and Time

#### Management Reports

##### *Injury Outcome by Month of Crash in Maine*

Karl Finison and Gary Menchen

Scope	All persons involved in 1991 motor vehicle crashes statewide in Maine
Data Used	Crash linked to EMS, hospital and census data
Format	Management Report
Description	This management report presents by month for persons injured in motor vehicle crashes the total occupants, total injured, total transported by EMS, total admitted to a hospital, total with severe injury ISS>15, total charges, total with head/spinal injuries, total deaths, and the years of potential life lost.
Contact Person	Karl Finison TEL: 207.623.2555; FAX: 207.622.7086 email: kfinison@mhic.org

##### *Injury Outcome by Day of Week of Crash in Maine*

Maine CODES Board of Directors

Scope	All persons involved in 1995 motor vehicle crashes statewide in Maine
Data Used	Crash linked to EMS, hospital and census data
Format	Management Report
Description	This management report presents by day of week in Maine, the total number of crashes and vehicles involved, total persons involved, total and percent injured, the observed expected ratio, total transported by EMS, total hospitalized, total hospital days and charges, total head injuries, total deaths, and the years of potential life lost.
Contact Person	Cathy St. Pierre TEL: 207.624.5467; FAX: 207.624.5470 email: cathy.s.stpierre@state.me.us

3.1.6 Day/Time



### *Injury Outcome by Time of Crash in Maine*

Karl Finison and Gary Menchen

Scope	All persons involved in 1991 motor vehicle crashes statewide in Maine
Data Used	Crash linked to EMS, hospital and census data
Format	Management Report
Description	This management report presents by time of crash in Maine using one hour intervals, the total occupants, total injured, percent of total injures, total transported by EMS, total admitted to a hospital, total with severe injury ISS>15, total charges, total with head/spinal injuries, total deaths, and the years of potential life lost.
Contact Person	Karl Finison TEL: 207.623.2555; FAX: 207.622.7086 email: kfinison@mhic.org

### **3.1.7 By Type of Injury**

#### **Studies**

### *Case-Control Analysis of Traumatic Brain Injury in Motor Vehicle Crashes (In Process)*

Carl Spurlock, Michael Singleton and Jay Christian

Scope	All drivers involved in 1997 crashes in Kentucky
Data Used	Crash data linked to TBI cases taken from trauma registries, hospital discharges, and death certificates.
Format	Study
Description	A total 618 drivers were selected from 1,213 fatal and nonfatal TBI cases that had been identified using the standard Centers for Disease Control and Prevention (CDC) definition. The driver TBI cases were obtained from linked crash, hospital discharge, death certificate, and trauma registry. These TBI drivers are being matched against the 1997 crash file. From the unlinked crashes, two controls will be selected at random for each linked TBI driver. Logistic regression will be used to determine the predictive value of driver age and gender, type of crash, type of roadway on which the crash occurred, type of vehicle being driven, use of occupant safety equipment by the driver, and driver use of alcohol or other drugs for TBI as a result of a crash.
Contact Person	Michael Singleton TEL: 606.323.4250 FAX: 606.257.3909 email: msingle@pop.uky.edu

3.1.7 Injury

*Lower Extremity Fractures Among Restrained Vehicle Occupants in Maryland*

Patricia C. Dischinger

Scope	Hospitalized drivers involved in crashes of automobiles, light trucks, and vans in Maryland for the years 1995-1996
Data Used	Crash linked to inpatient hospital discharge data
Format	Study - Presentation to American Public Health Association 126 Annual Meeting, 1998
Description	This study examines the epidemiology of lower extremity fractures incurred in motor vehicle crashes in terms of age, gender type of crash, point of impact, type of vehicle, vehicle damage extent, seat belt use, airbag, type of lower extremity fracture, injury severity score, length of stay, hospital cost, and hospital disposition.
Contact person	Patricia C. Dischinger TEL: 410.328.4246; FAX: 410.328.3699 email: pdischin@nsc.ummc.umaryland.edu

*Use of CODES Linked Data to Evaluate Traumatic Brain Injury in New Mexico*

Stuart Castle and Brian Woods

Scope	All persons involved in 1995 crashes statewide in New Mexico
Data Used	Crash linked to trauma registry, hospital discharge, Medicaid, and Office of the Medical Investigator.
Format	Study
Description	This study reports on the incidence and cost of motor vehicle and non-motor vehicle related causes of Traumatic Brain Injury. Linked data are used to identify TBI cases that are unique to each data file and those that appear in more than one data file. The study population is described in terms of age, gender, external cause, types of crash vehicles, use of safety equipment, vehicle characteristics, type of road system, county, hospital length of stay, length of unconsciousness, and total charges by mortality/morbidity. In addition, the study indicates the odds of TBI by type of crash severity (towaway, no belts) or by injury categories (fatal/no belt, incapacitating/no belt/ nonincapacitating/no belt, possible/no belt).
Contact Person	Stuart Castle TEL:505.827.2915; FAX: 505.827.0013 email: stuartc@doh.state.nm.us

*Serious Lower Extremity Injuries in Motor Vehicle Crashes: An Example of Injury Research Using Linked Motor Vehicle Crash and Hospital Discharge Data in Wisconsin*

Trudy Karlson, Ph.D. and Wayne Bigelow

Scope	All persons involved in 1990-1994 motor vehicle crashes statewide in Wisconsin
Data Used	Crash data linked to hospital discharge and Medicaid data.
Format	Study
Description	This study reports incidence variations and cost of serious lower extremity injuries from crashes during 1990-1994. Driver age, gender, occupant seating position, use of restraints (including air bag), crash configuration, estimated speed of crash, vehicle type, weight, and other characteristics are evaluated as potential factors for affecting severity and type of injury. Who pays is identified in addition to the distribution of public and private payer sources. Analyses use restraint as reported or as likely based on independent field observation. Serious lower extremity injury are defined as ICD-9-CM 821.00-829.99, 836.00-838.99, 928.00-928.99, 895.00-897.99. Abrasions, contusions and lacerations, strains and sprains are excluded. Costs include hospital charges, estimates for rehabilitation time and treatment for lower extremity injuries, plus Medicaid histories to determine first year physical therapy and other outpatient costs.
Contact Person	Martha Florey TEL: 608.266.3557; FAX: 608.267.0441 email: mflorey@mail.state.wi.us

*Evaluating the Impact of Reported Seat Belt Use on Hospitalizations and Subsequent Deaths Resulting from Brain Injuries in Wisconsin*

Trudy Karlson, Ph.D.

Scope	All persons involved in 1991 motor cycle crashes in Wisconsin
Data Used	Crash data linked to hospital discharge
Format	Study
Description	This study determines the risk for head injury for motorcyclists drivers and riders involved in crashes and the hospital charges for these injuries. Estimates of the effectiveness of helmet use in reducing motorcycle crash injuries and fatalities are also presented. Head injury is defined as intracranial injury with or without skull fracture; intracranial hemorrhage; skull fracture with no intracranial injury; concussion with minimal or no loss of consciousness. Results are presented by helmet use and type of head injury. Limitations of the study are discussed.
Contact Person	Martha Florey TEL: 608.266.3557; FAX: 608.267.0441 email: mflorey@mail.state.wi.us

3.1.7 Injury

### 3.1.8 Type of Treatment for Injury

#### Studies

##### *Investigating Auto Injury Treatment in a No-fault State: An Analysis of Linked Crash and Auto Insurer Data in Hawaii*

Lawrence H. Nitz and Karl Kim

Scope	All persons involved in motor vehicle crashes occurring between 1990-1991 in Hawaii.
Data Used	Crash data linked to auto insurance claims data.
Format	Study
Description	This study evaluates the choice of care among crash victims in terms of who goes to a chiropractor. It also discusses the relationship between occupant, vehicle and crash characteristics and the choice of care. Hawaii is a no-fault insurance state
Contact Person	Karl Kim TEL: 808.956.7381; FAX: 808.956.6870 email: karlk@hawaii.edu

### 3.2 Health Care Costs

#### 3.2.1 Costs and Safety Belt Use

#### Studies

##### *Focus...Injuries and Costs Associated with Failure to Use Seat Belts in Missouri*

Mark Van Tuinen

Scope	All drivers involved in 1990 motor vehicle crashes statewide in Missouri
Data Used	Crash linked to EMS, emergency department, hospital and insurance claims data
Format	Study
Description	This study presents Missouri specific results about the effectiveness of safety belts on injuries and costs.
Contact Person	Mark Van Tuinen TEL: 573.751.6274; FAX: 573.526.4102 email: vantum@mail.health.state.mo.us

3.2.1 Costs and Belts

*Analysis of Collision Seat Belt Use and Average Hospital Charge 1995-96 in Nevada* (in process)  
 G. Tom Shires, M.D. and John Fildes, M.D.

Scope	All drivers reported on 108,770 police reports of crashes occurring in Nevada during 1995-1996.
Data Used	Crash linked to EMS and inpatient hospital discharge data
Format	Study
Description	This study will compare the average hospital charges for police reported belted and unbelted drivers involved in different types of crashes. Average hospital inpatient charges will be determined from 580 hospital records linked to crash data. Preliminary results indicate that unbelted occupants had a higher liability (\$24,500) than those belted (\$12,400), resulting in a difference of 51%. This information is significant for traffic safety planning since between 1991-1997, crashes in Nevada increased from 37,840 annually to 58,970, an increase of 36% with an average economic loss in excess of \$1,211,601,200 .
Contact Person	John Fildes TEL: 702.671.2338; FAX: 702.385.2701 email: jfildes@nvtrauma.com

### Management Reports

*Charges by Belt Use by Payer Source in Wisconsin*  
 Wayne Bigelow

Scope	All persons involved in 1992-1997 crashes in Wisconsin
Data Used	Crash data linked to inpatient hospital discharge data.
Format	Management Report
Description	This series of management reports consists of 3 reports. Primary payer is defined as Medicare, Medicaid, Other Gov., private, self pay, other or unknown. Total number, inpatient charges and average charges are reported by age group: <5 years, 5-18 years, 19-64 years, 65-74 years, 75 years and greater, unknown. Table 1 presents data for belted occupants. Table 2 presents data for unbelted occupants. Table 3 presents the average difference in average charges for non-belted compared to belted crash occupants.
Contact Person	Martha Florey TEL: 608.266.3557; FAX: 608.267.0441 email: mflorey@mail.state.wi.us

3.2.1 Costs and Belts

### 3.2.2 Hospital Charges

#### Studies

##### *Comparative Analysis of Hospital Charges Among Motor Vehicle Crashes in Maryland*

Joseph A. Kufera, Patricia C. Dischinger, Timothy Kerns, Shiu M. Ho

Scope	Hospitalized drivers involved in 1991-1995 motor vehicle crashes in Maryland
Data Used	Crash reports linked with inpatient hospital discharge data
Format	Poster presentation, Society of Epidemiologic Research, Baltimore, 1999
Description	This study presents the differences in hospital charges between various driver, vehicle and crash characteristics. The results discuss the influence of seatbelt use/non-use as a major determinant of hospital costs.
Contact person	Joseph A. Kufera, TEL: 410.328.4161; FAX: 410.328.3699 email: jkufera@nsc.ummc.umaryland.edu

##### *Using Path Analysis to Identify Direct and Indirect Effects of Motor Vehicle Crash Factors on Hospital Charges in Nebraska*

Dan Christensen and Ming Qu

Scope	All drivers who did not die but who incurred medical charges (inpatient or outpatient) in Nebraska in 1997.
Data Used	Crash linked to hospital
Format	Study
Description	This study describes the direct and indirect effects of several crash factors on hospital charges using structural equation models. This study goes beyond simple linear regression and explores the causal relationships among the crash factors. By exploring these causal relationships, the total impact of these factors on charges can be assessed by looking at both direct and indirect effects.
Contact Person	Dan Christensen TEL: 402.471.7988; FAX: 402.471.6436 Email: dan.christensen@hhss.state.ne.us

3.2.2. Hospital Charges

*Using Linked Data to Evaluate Hospital Charges for Motor Vehicle Crash Victims in Pennsylvania*

Michael Allen and Harold Weiss

Scope	All persons involved in 1994 police reported motor vehicle crashes statewide in Pennsylvania
Data Used	Crash linked to EMS and inpatient hospital discharge data
Format	Study
Description	This study describes total and average hospital charges for motor vehicle crash victims as a function of various victim, crash, and vehicle characteristics such as safety belt use, seat position, payer, age, type of crash, type of vehicle and alcohol involvement. Characteristics of groups of individuals and vehicles which are associated with high and low hospital costs and who pays for these costs are identified. Expected payer source is obtained from the inpatient hospital discharge data.
Contact Person	Hank Weiss TEL: 412.648.9290; FAX: 412.648.8924 email: hweiss@injurycontrol.com

**Fact Sheets**

*Total and Average Hospital Charges by County of the Crash Location in Iowa*

Dick Harmon

Scope	Persons injured and hospitalized as a result of a motor vehicle crash in 1996 in Iowa.
Data Used	Crash linked to inpatient hospital discharge data
Format	Fact Sheet
Description	This fact sheet reports the total and average hospital charges by county of the crash location. It also presents the statewide total and average hospital charges.
Contact Person	Dick Harmon TEL: 515.281.5737; FAX: 515.281.4958 email: dharmon@health.state.ia.us

3.2.2. Hospital Charges

*Total and Average Hospital Charges by Age Group for Persons Involved in Motor Vehicle Crashes in Iowa*

Dick Harmon

Scope	Persons injured and hospitalized as a result of a motor vehicle crash in 1996 in Iowa.
Data Used	Crash linked to inpatient hospital discharge data
Format	Fact Sheet
Description	This fact sheet presents two graphs. The first displays the total and average hospital charges for ages 14 and under, 15, 16, 17, 18, 19 and 20. The second displays the total and average hospital charges for ages 14 and under, 15-24, 25-34, 35-44, 45-54, 55-64, 65-74 and 75 and over.
Contact Person	Dick Harmon TEL: 515.281.5737; FAX: 515.281.4958 email: dharmon@health.state.ia.us

*Total Hospital Charges by Type of Crash in Iowa*

Dick Harmon

Scope	Persons injured and hospitalized as a result of a motor vehicle crash in 1996 in Iowa.
Data Used	Crash linked to inpatient hospital discharge data
Format	Fact Sheet
Description	This fact sheet summarizes information for collision and non-collision crashes. Pie charts are used to display the percentage of occurrence and the total hospital charges by crash type.
Contact Person	Dick Harmon TEL: 515.281.5737; FAX: 515.281.4958 email: dharmon@health.state.ia.us

3.2.2. Hospital Charges



*Total Occurrences and Total and Average Hospital Charges by Type of Non-Collision Motor Vehicle Crash in Iowa*

Dick Harmon

Scope	Persons injured and hospitalized as a result of a non-collision motor vehicle crash in 1996 in Iowa.
Data Used	Crash linked to inpatient hospital discharge data
Format	Fact Sheet
Description	This fact sheet reports the persons involved in non-collision motor vehicle crashes and their total hospital inpatient charges. A bar chart displays the total persons injured and hospitalized for each of six types of non-collision motor vehicle crashes. A graph displays the total and average hospital charges for the same groups.
Contact Person	Dick Harmon TEL: 515.281.5737; FAX: 515.281.4958 email: dharmon@health.state.ia.us

### 3.2.3 Medicaid and Costs

#### Studies

*The Cost of Motor Vehicle Crash Injuries to the Wisconsin Medicaid Program*

Trudy A. Karlson, Martha D. Sumi, Daniel Wickeham, Charles Quade, and Sara Karon

Scope	All persons involved in 1991 motor vehicle crashes statewide in Wisconsin.
Data Used	Crash linked to Medicaid data
Format	Study
Description	This study describes an algorithm developed to identify the crash-related health care specifically provided by physician, hospital, long term care, and other services to Medicaid beneficiaries. It identifies the cost of this care for beneficiaries who were occupants, pedestrians, or motorcyclists. Costs are identified for (1) individuals who were Medicaid-eligible prior to the crash, and (2) individuals who became eligible immediately following the crash as a result of severe injuries requiring expensive care. Costs for those who became eligible two or three years after the crash when the payments from their liability settlements finally ran out are not included. Alcohol and safety belt use are considered in relation to the costs.
Contact Person	Martha Florey TEL: 608.266.3557; FAX: 608.267.0441 email: mflorey@mail.state.wi.us

3.2.3 Medicaid

### 3.2.4 Vehicle Insurance Claims

*Community Crash Injury Profiles Using Unlinked and Linked Hospital, Insurance and Crash Data - Massachusetts 1996*

Nick Mango, Elizabeth Garthe, Brad Prenney, Thomas M. McGovern

Scope	All persons involved in motor vehicle crashes in Massachusetts during 1996.
Data Used	Unlinked and linked crash, insurance claims and inpatient hospital discharge data
Format	Study
Description	Unlinked and linked CODES data are used to demonstrate their use in developing community-based crash injury profiles for use by communities striving to prevent or reduce crash injuries and deaths. Financial information is conservatively calculated based on first claim and first admission. The profiles present total crashes, hospital charges and insurance claims as well as crash, charge and claim rates per 100,000 population. by community and statewide.
Contact Person	Brad Prenney TEL: 617.284.8401; FAX: 617.284.8456 email: brad.prenney@state.ma.us

3.2.4 Insurance

## 4.0 APPLICATIONS FOR TRAFFIC SAFETY

### 4.1 Crash Characteristics

#### Studies

##### *Crash and Injury Outcome Multipliers in Hawaii*

Karl Kim

Scope	All persons involved in motor vehicle crashes occurring between 1986-1996 in Hawaii. Crash linked to EMS and claims data for 1990-93 and crash linked to hospital data for 1993-96 were also used.
Data Used	Crash data linked to EMS and hospital data.
Format	Study
Description	This study presents crash and injury outcome multipliers to examine the relative safety of various types of crashes. Using the crash as the unit of analysis, a measure is derived for the number of fatalities, incapacitating, non-serious injuries, EMS transports and hospitalizations that are produced by a particular crash type. The measure can be used to compare the seriousness of different types of crashes and safety concerns. The technique is illustrated using both police crash injury data (KABCO) as well as linked CODES data. Potential uses for the measure are described.
Contact Person	Karl Kim TEL: 808.956.7381; FAX: 808.956.6870 email: karlk@hawaii.edu

4.1 Crash

*Analysis of 1996 Crashes Involving Vehicles That “Ran Off the Road” in Maine*

Karl Finison and Robert B. DuBrow

Scope	All Maine drivers involved in 1996 single vehicle police reported crashes in Maine; Additional information added on outcomes for passengers.
Data Used	Crash linked to EMS, hospital discharge and death certificate data; road characteristic data (federal functional class, pavement width, shoulder width, million vehicle miles traveled) and total Maine licensed drivers were added to the linked data set.
Format	Study
Description	This study focuses primarily on non-weather related ROR crashes. The independent variables include driver factors: alcohol, illegal or unsafe speed, asleep or fatigued, driver’s age and sex and seat belt use. Road factors include federal functional class (interstate, arterial, collector, local), shoulder type, pavement width, speed limit (as reported by police), and location at a curve in the road. Other factors explore time of day (8PM to 4AM vs daytime), location (rural vs urban), fixed objects struck (utility poles, trees), day of week, and month of year. Dependent variables include police reported fatal, incapacitating, non-incapacitating injury or possible or no injury with a linkage to an EMS or hospital discharge record.
Contact Person	Cathy St. Pierre TEL: 207.624.5467; FAX: 207.624.5470 email: cathy.s.stpierre@state.me.us

*Patterns of Injury in Frontal Collisions With and Without Airbags in Maryland*

Patricia C. Dischinger

Scope	Hospitalized, restrained drivers injured in non-rollover frontal automobile collisions in Maryland, 1993-1994
Data Used	Crash report linked to inpatient hospital discharge data
Format	Study - Presentation to 1996 international IRCOBI conference on the biomechanics of impact
Description	This study presents the results of analyses of injury types to determine differences for those drivers in collisions with and without airbags. Chi square tests or t-tests, where appropriate, are used to test for statistical differences.
Contact person	Patricia C. Dischinger TEL: 410.328.4246; FAX: 410.328.3699 email: pdischin@nsc.ummc.umaryland.edu

*Overturn Crashes and Injury in New Mexico*

Carrie Rudd

Scope	All persons in 1995 motor vehicle crashes statewide in New Mexico
Data Used	Crash linked to trauma registry, hospital discharge, and Office of the Medical Investigator
Format	Study
Description	This study focuses on passenger vehicle overturns and injury outcome with particular emphasis on spinal cord and traumatic brain injuries. Type of road (urban/rural), alcohol use, speed and restraint use are evaluated as contributing factors.
Contact Person	Stuart Castle TEL:505.827.2915; FAX: 505.827.0013 email: stuartc@doh.state.nm.us

*Crash Parameters and Cost of Care in New York ( in process)*

Anne Dowling

Scope	All persons involved in 1992 motor vehicle crashes statewide in New York
Data Used	Crash linked to EMS, emergency department, hospital and insurance claims data
Format	Study
Description	This study constructs models to predict case level cost using the maximum abbreviated injury scale (MAIS) or the Injury Severity Score (ISS) for translation to injury severity, body region, and average cost. Transfers, extraordinary treatment cases, or other outliers also are considered. Average and total charges are calculated for both models to determine the impact of the different methodologies.
Contact Person	Anne Dowling TEL: 518.453.0291; FAX: 518.453.0298 adowling@global2000.net

4.1 Crash

## Fact Sheets

### *Drivers Who Ran Off the Road, Maine Crash Facts, 1996*

Karl Finison and Robert B. DuBrow

Scope	All Maine drivers involved in 1996 single vehicle police reported crashes in Maine; Additional information added on outcomes for passengers.
Data Used	Crash linked to EMS, hospital discharge and death certificate data; road characteristic data (federal functional class, pavement width, shoulder width, million vehicle miles traveled) and total Maine licensed drivers were added to the linked data set.
Format	Fact Sheet
Description	This Fact Sheet presents tables indicating the driver injury rate for run-off-the road crashes by federal functional class (interstate, arterial, collector, local) and by age (16, 17, 18, 19, 20, 21, 22, 23, 24, 25-29, 30-34, 35-39, 40-44, 45-49, 50-54, 55-59, 60-64, 65-69, 70 and above) and sex. Total drivers injured in alcohol related ROR crashes are presented by day of week and age group (16-24, 25 and over). For Maine drivers and their passengers involved in ROR crashes, data present total injured, transported by EMS, hospital days, hospital charges, hospitalized or died, and years of potential life lost.
Contact Person	Cathy St. Pierre TEL: 207.624.5467; FAX: 207.624.5470 email: cathy.s.stpierre@state.me.us

## Management Reports

### *Injury Outcome by Posted Speed Limit in Maine*

Karl Finison and Garry Menchen

Scope	All persons involved in 1991 motor vehicle crashes statewide in Maine
Data Used	Crash linked to EMS, hospital, and census data
Format	Management Report
Description	This management report presents by posted speed limit in Maine, using 5 mile intervals 25-65, unknown/missing, invalid, the total occupants, total injured, percent of total injures, total transported by EMS, total admitted to a hospital, total with severe injury ISS>15, total charges, total with head/spinal injuries, total deaths, years of potential life lost and the relative risk.
Contact Person	Karl Finison TEL: 207.623.2555; FAX: 207.622.7086 email: kfinison@mhic.org

4.1 Crash

*Injury Outcome by Type of Crash in Maine*

Maine CODES Board of Directors

Scope	All persons involved in 1995 motor vehicle crashes statewide in Maine.
Data Used	Crash linked to EMS, hospital and census data
Format	Management Report
Description	This management report presents by type of crash, the total number of crashes, total vehicles involved, total persons involved, total and percent injured, observed expected ratio, total transported by EMS, total hospitalized, total hospital days, total hospital charges, total with head injury, total fatalities, and years of potential life lost. Crash type is defined to include object in road, rear end/side swipe, head on/sideswipe, intersection movement, pedestrians, train, ran off road, animal, bike, other, jack knife, rollover, fire, submersion, rock thrown, not coded and totals.
Contact Person	Cathy St. Pierre TEL: 207.624.5467; FAX: 207.624.5470 email: cathy.s.stpierre@state.me.us

*Injury Outcome by Roadway Location of Crash in Maine*

Maine CODES Board of Directors

Scope	All persons involved in 1995 motor vehicle crashes statewide in Maine
Data Used	Crash linked to EMS, hospital, and census data
Format	Management Report
Description	This management report presents by type of roadway location, the total number of crashes, total vehicles involved, total persons involved, total and percent injured, observed expected ratio, total transported by EMS, total hospitalized, total hospital days, total hospital charges, total with head injury, total fatalities, and years of potential life lost. Location of crash is defined as straight road, curved, 3 leg intersection, 4 leg intersection, 5 leg intersection, driveways, bridges, interchange, other, not coded.
Contact Person	Cathy St. Pierre TEL: 207.624.5467; FAX: 207.624.5470 email: cathy.s.stpierre@state.me.us

4.1 Crash

*Injury Outcome by Light Conditions for Crashes in Maine*

Maine CODES Board of Directors

Scope	All persons involved in 1995 motor vehicle crashes statewide in Maine
Data Used	Crash linked to EMS, hospital, and census data
Format	Management Report
Description	This management report presents by light condition of the crash the total crashes, total vehicles involved, total persons involved, total and percent injured, observed expected ratio, total transported by EMS, total hospitalized, total hospital days, total charges, total head injuries, total deaths, years of potential life lost. Light conditions are defined as dawn (morning), daylight, dusk (evening), dark (street lights on), dark (no street lights), dark (street lights off), other, not coded.
Contact Person	Cathy St. Pierre TEL: 207.624.5467; FAX: 207.624.5470 email: cathy.s.stpierre@state.me.us

*Injury Outcome by Road Surface for Crashes in Maine*

Maine CODES Board of Directors

Scope	All persons involved in 1995 motor vehicle crashes statewide in Maine
Data Used	Crash linked to EMS, hospital, and census data
Format	Management Report
Description	This management report presents by road surface for crashes the total crashes, total vehicles involved, total persons involved, total and percent injured, observed expected ratio, total transported by EMS, total hospitalized, total hospital days, total charges, total head injuries, total deaths, years of potential life lost. Road surface is defined as dry, wet, snow/slush sanded and not sanded, ice packed snow sanded and not sanded, muddy, debris, oily, other, not coded.
Contact Person	Cathy St. Pierre TEL: 207.624.5467; FAX: 207.624.5470



*Injury Outcome by Type of Road Work at Crash in Maine*

Karl Finison and Gary Menchen

Scope	All persons involved in 1991 motor vehicle crashes statewide in Maine
Data Used	Crash linked to EMS, hospital, and census data
Format	Management Report
Description	This management report presents by type of road work at crash the total occupants, total injured, percent of total injured, total transported by EMS, total admitted to a hospital, total with severe injury ISS>15, total charges, total with head/spinal injuries, total deaths and years of potential life lost. Road work is defined as none, construction zone, maintenance area, utility work area, missing/invalid/other.
Contact Person	Karl Finison TEL: 207.623.2555; FAX: 207.622.7086 email: kfinison@mhic.org

*Injury Outcome by Apparent Contributing Factors in Single Vehicle Crashes in Maine*

Karl Finison and Gary Menchen

Scope	All persons involved in 1991 motor vehicle crashes statewide in Maine
Data Used	Crash linked to EMS, hospital, and census data
Format	Management Report
Description	This management report presents by apparent contributing factor in single vehicle crashes, the total occupants, total injured, percent of total injured, total transported by EMS, total admitted to a hospital, total with severe injury ISS>15, total charges, total with head/spinal injuries, total deaths and years of potential life lost. Results are shown separately for thirty different apparent contributing factors.
Contact Person	Karl Finison TEL: 207.623.2555; FAX: 207.622.7086 email: kfinison@mhic.org

4.1 Crash

*Injury Outcome by Apparent Contributing Factors in Multiple Vehicle Crashes in Maine*  
Karl Finison and Gary Menchen

Scope	All persons involved in 1991 motor vehicle crashes statewide in Maine
Data Used	Crash linked to EMS, hospital, and census data
Format	Management Report
Description	This management report presents by apparent contributing factor in multiple vehicle crashes, the total occupants, total injured, percent of total injured, total transported by EMS, total admitted to a hospital, total with severe injury ISS>15, total charges, total with head/spinal injuries, total deaths and years of potential life lost. Results are shown separately for thirty different apparent contributing factors.
Contact Person	Karl Finison TEL: 207.623.2555; FAX: 207.622.7086 email: kfinison@mhic.org

## 4.2 Vehicle Characteristics

### Studies

*Using Linked Data to Support Truck Safety in South Dakota (in process)*

Kareen Dougherty

Scope	All occupants of commercial trucks involved in 1995-1998 motor vehicle crashes statewide in South Dakota
Data Used	Crash linked to SAFETYNET FHWA data, driver licensing and inpatient hospital discharge data
Format	Study
Description	The CODES linked data will be used to evaluate the relationship between crash severity (fatal, incapacitating, non-incapacitating, possible injury, property damage only) with vehicle type/body style, contributing factors, and geographic locations. The purpose will be to identify factors that contribute to commercial truck crashes in South Dakota and to recommend data-driven prevention strategies.
Contact Person	Kareen Dougherty TEL: 605.367.5252; FAX: 605.677.5427 email: kdougher@charlie.usd.edu

4.2 Vehicle

## Management Reports

### *Injury Outcome by Vehicle Type for Crashes in Maine*

Maine CODES Board of Directors

Scope	All persons involved in 1995 motor vehicle crashes statewide in Maine
Data Used	Crash linked to EMS, hospital, and census data
Format	Management Report
Description	This management report presents by type of vehicle, the total vehicles involved, total persons involved, total and percent injured, observed expected ratio, total transported by EMS, total hospitalized, total hospital days, total hospital charges, total with head injury, total fatalities, and years of potential life lost. Vehicle type defined as an passenger cars, vans/light trucks, motorbikes, school bus, commercial trucks, bicycles, pedestrians, other/unknown.
Contact Person	Cathy St. Pierre TEL: 207.624.5467; FAX: 207.624.5470 email: cathy.s.stpierre@state.me.us

### *Injury Outcome by Type of Emergency Vehicle Involved in Crash in Maine*

Karl Finison and Gary Menchen

Scope	All persons involved in 1991 motor vehicle crashes statewide in Maine
Data Used	Crash linked to EMS, hospital, and census data
Format	Management Report
Description	This management report presents by type of emergency vehicle involved at crash the total occupants, total injured, percent of total injured, total transported by EMS, total admitted to a hospital, total with severe injury ISS>15, total charges, total with head/spinal injuries, total deaths and years of potential life lost. Emergency vehicle involved is defined as no, police vehicle, ambulance, fire department, wrecker (enroute), other, missing/invalid.
Contact Person	Karl Finison TEL: 207.623.2555; FAX: 207.622.7086 email: kfinison@mhic.org

4.2 Vehicle

## 4.3 Person Characteristics

### 4.3.1 Safety Belts

#### Studies

*Report to Congress on Benefits of Safety Belts and Motorcycle Helmets, Based on Data from the Crash Outcome Data Evaluation System (CODES)*

National Highway Traffic Safety Administration (1996).

Scope	All occupants of police reported crashes statewide for 1990, 1991, or 1992 in Hawaii, Maine, Missouri, New York, Pennsylvania, Utah, Wisconsin
Data Used	Statewide crash linked to EMS, hospital, and other state data by seven states and the state results statistically combined by NHTSA
Format	Study
Description	Occupant-specific, population-based outcome information used to evaluate the effectiveness of safety belts and motorcycle helmets in terms of mortality, morbidity, severity, and cost.
Contact Person	Dennis Utter, NHTSA TEL: 202.366.5351, FAX: 202.366.3189

*NHTSA Technical Report: The Crash Outcome Evaluation System (CODES)*

Johnson, Sandra W. and Walker, Jonathan

Scope	All occupants of police reported crashes statewide for 1990, 1991, or 1992 in Hawaii, Maine, Missouri, New York, Pennsylvania, Utah, Wisconsin
Data Used	Statewide crash linked to EMS, hospital, and other state data by seven states and the state results statistically combined by NHTSA
Format	Study
Description	This report presents technical information about the probabilistic linkage process and the state specific linkage and analytical results as background reference for the <i>Report to Congress on the Benefits of Safety Belts and Motorcycle Helmets</i> .
Contact Person	Sandra Johnson, NHTSA TEL: 202.366.5364, FAX: 202.366.3189

*Analysis of Seat Belt Use and Outcomes in Maine Crashes in 1996*

Karl Finison and Robert B. Dubrow

Scope	Occupants 5 years and older of passenger cars, vans and light trucks involved in 1996 police reported motor vehicle crashes statewide in Maine;
Data Used	Crash linked to EMS, hospital and death certificate data.
Format	Study
Description	This study analyzes the relationship between seat belt use and outcome. Independent variables include belt use, occupant age, sex, seating position (driver, front seat passenger, rear seat), location of crash (rural/urban), speed limit, road conditions (wet vs. dry), time (8 PM to 4 AM vs daytime), intersection crash, type of crash (rollover, single vehicle hitting a fixed object, other single vehicle, and multi-vehicle head-on), rollover, and type of vehicle (passenger car vs van or light truck). The dependent variables are defined as: any injury; any EMS transport, hospital discharge or death; any hospital discharge or death with any ICD-9-CM code indicating a head injury; or any death.
Contact Person	Cathy St. Pierre TEL: 207.624.5467; FAX: 207.624.5470 email: cathy.s.stpierre@state.me.us

*Safety Belts and Head and Spinal Injuries in Maine*

Karl Finison, Christiana Cook, Gary Menchen, and Douglas Thompson

Scope	All persons involved in 1991 motor vehicle crashes statewide in Maine
Data Used	Crash linked to EMS, hospital, and census data
Format	Study
Description	This study measures the effectiveness of safety belts to reduce the risk for head and spinal injuries using three outcome measures: reported by police, reported by EMS, or reported by hospital. Study populations include occupants of cars and light trucks.
Contact Person	Karl Finison TEL: 207.623.2555; FAX: 207.622.7086 email: kfinison@mhic.org

4.3.1 Belts

*Within Vehicle Analysis of the Effectiveness of Seat Belts in Maine*

Douglas Thompson

Scope	All persons involved in 1991 motor vehicle crashes statewide in Maine
Data Used	Crash linked to EMS, hospital, and census data
Format	Study
Description	This within-vehicle analysis uses conditional logistic regression to determine whether alternative analytic techniques lead to similar conclusions as those prepared using NHTSA's mandated CODES model. This type of analysis provides more control for the circumstances and severity of the crash than is possible based on measured variables, and generates estimates that may be more easily aggregated across states than estimates based on standard unconditional logistic regression.
Contact Person	Karl Finison TEL: 207.623.2555; FAX: 207.622.7086 email: kfinison@mhic.org

*Application of Ordered Logistic Regression to Evaluate the Efficacy of Seat Belts and Helmets for Prevention of Injury in Maine*

Christiana Cook

Scope	All persons involved in 1991 motor vehicle crashes statewide in Maine
Data Used	Crash linked to EMS, hospital, and census data
Format	Study
Description	An ordered logistic regression model is used to obtain greater power to reject the null hypothesis (belts or helmets are not effective) when it is false than that provided by the NHTSA mandated model. Results indicate that the new model was better for the helmet analysis but not the safety belt analysis.
Contact Person	Karl Finison TEL: 207.623.2555; FAX: 207.622.7086 email: kfinison@mhic.org

4.3.1 Belts

*Unsafe Driving Behaviors and Hospitalization in Missouri.*

Mark Van Tuinen

Scope	All drivers involved in 1990 motor vehicle and motorcycle crashes statewide in Missouri
Data Used	Crash linked to EMS, emergency department, hospital and insurance claims data
Format	Study
Description	This study presents Missouri specific results about the effectiveness of safety belts and motorcycle helmets on reducing the need for hospitalization as the result of a motor vehicle crash.
Contact Person	Mark Van Tuinen TEL: 573.751.6274; FAX: 573.526.4102 email: vantum@mail.health.state.mo.us

*Motor Vehicle Crashes in 1995-1996 and Their Outcomes by Safety Belt Use Statewide in Oklahoma*

Ross Clarke

Scope	All occupants involved in 1995-1996 police reported motor vehicle crashes statewide in Oklahoma.
Data Used	Crash linked to EMS and inpatient hospital discharge data.
Format	Study
Description	This study presents data indicating level of police reported severity (KABCO), percent of drivers who died or were incapacitated, average and total inpatient charges and average inpatient charges. It arrays the data by safety belt use (unknown, unbelted, seatbelt, shoulder strap only, seatbelt and shoulder strap) using several tables. In addition, percent of drivers involved in crashes not using seat belts are reported by county. Data are reported separately for 1995-1996.
Contact Person	Ross Clarke TEL 405.271.3407; FAX: 405.271.3397 email: ross-clarke@ouhsc.edu

4.3.1 Belts

*Analysis of Seat Belt Usage on Motor Vehicle Crash-Related Injuries in Utah Using a Model of Injury Severity Based Upon EMS Interventions*

J. Michael Dean, Jim Reading, Pat Nechodom

Scope	All persons involved in 1991 motor vehicle crashes statewide in Utah
Data Used	Crash linked to EMS data
Format	Study
Description	This study describes the relationship of safety belt use and need for specific EMS treatments. Two models of injury severity based upon EMS interventions are developed to evaluate the effects of seat belt usage on crash related characteristics which affect injury severity. Data were analyzed using logistic regression. Results show that more serious EMS treatments (e.g., bleeding control, cervical immobilization, intravenous placement, oxygen therapy, spinal immobilization, and ventilation) are less likely in belted occupants who had an EMS response.
Contact Person	Janet Almond TEL: 801.585.6410 FAX: 801.581.8686 email: janet.almond@hsc.utah.edu

*Seat Belt and Airbag Effectiveness in Motor Vehicle Crashes Vary Little With Driver Height or Weight in Utah.*

Howard M. Corneli, Dan Leonard, J. Michael Dean

Scope	All drivers involved in police-reported motor vehicle crashes in Utah during 1996.
Data Used	Crash linked to EMS, emergency department, hospital and drivers' license data.
Format	Study
Description	This study uses log-linear modeling to examine the effect of driver height and weight on overall outcome and specific injuries in motor vehicle crashes. Men and women are analyzed separately, first by height and weight quartile, then by comparing those less than the 10th percentile or greater than the 90 <sup>th</sup> percentile to the rest. Use of seat belts and the availability of a driver's airbag are considered. Restraint use, outcomes of EMS transport, ED or hospital admission, Injury Severity Score, length of stay, charges, and death are analyzed in relation to height and weight.
Contact Person	Janet Almond TEL: 801.585.6410 FAX: 801.581.8686 email: janet.almond@hsc.utah.edu

4.3.1 Belts



*Shoulder Belts in Motor Vehicle Crashes: A Statewide Analysis of Restraint Efficacy in Utah*  
 Stacey Knight, Lawrence J. Cook, Patricia J. Nechodom, Lenora M. Olson, James C. Reading,  
 J. Michael Dean

Scope	Front seat occupants over the age of 11 years in passenger cars in Utah between 1994 and 1996.
Data Used	Crash linked to inpatient hospital discharge data
Format	Study
Description	This study evaluates the effectiveness of a shoulder belt without a lap belt in reducing ejection, morbidity and mortality of front seat passengers involved in motor vehicle crashes in Utah. The effectiveness of shoulder belt only use in a motor vehicle crash is examined by analyzing linked police reported crash data with inpatient hospital discharge data for 1994-1996. Stochastic simulations are used to compensate for possible misclassification of seatbelt usage.
Contact Person	Janet Almond TEL: 801.585.6410 FAX: 801.581.8686 email: janet.almond@hsc.utah.edu

*Children in Motor Vehicle Crashes: Decreasing Protection with Increasing Age in Utah.*  
 Howard M. Corneli, James C. Reading, Lenora M. Olson, J. Michael Dean

Scope	All persons involved in 1992-1996 motor vehicle crashes in Utah
Data Used	Crash linked to EMS, emergency department and hospital data
Format	Study
Description	This study examines patterns of restraint use and injury among children in various age groups. Using multivariate methods, associations with age and restraint use are analyzed against injury, hospital admission and length of stay, hospital charges and death. Changing patterns of restraint use are analyzed in relation to the increased risk of injury in motor vehicle crashes by age.
Contact Person	Janet Almond TEL: 801.585.6410 FAX: 801.581.8686 email: janet.almond@hsc.utah.edu

4.3.1 Belts

## Fact Sheets

### *Do Seat Belts Reduce Injuries? Maine Crash Facts, 1996*

Karl Finison and Robert B. Dubrow

Scope	Occupants 5 years and older of passenger cars, vans and light trucks involved in 1996 police reported motor vehicle crashes statewide in Maine;
Data Used	Crash linked to EMS, hospital and death certificate data.
Format	Fact Sheet
Description	This fact sheet presents tables indicating injury outcomes (total injured, transported by EMS, inpatient hospital charges, hospitalized or died, hospitalized or died with head injury, fatalities, and years of potential life lost) for belted and unbelted occupants and the odds of injury for those unbelted compared to those belted. The national observational seat belt use rate is compared to Maine's rate for 1991-1998. Seat belt use rates are compared to hospitalization rates for occupants of passenger cars and light trucks age 5 and over.
Contact Person	Cathy St. Pierre TEL: 207.624.5467; FAX: 207.624.5470 email: cathy.s.stpierre@state.me.us

### *Ejections: Dangerous, Costly and Preventable in Missouri*

Mark Van Tuinen

Scope	All persons involved in 1993 and 1996 crashes in Missouri
Data Used	Crash data linked to inpatient hospital discharge data.
Format	Fact Sheet/Research Note
Description	This fact sheet/research note compares median inpatient charges and medical outcome (died or hospitalization) for ejected and non-ejected victims of motor vehicle crashes. The rate of ejection is associated with safety belt use which is compared by gender, vehicle type, and location in Missouri.
Contact Person	Mark Van Tuinen TEL: 573.751.6274; FAX: 573.526.4102 email: vantum@mail.health.state.mo.us

4.3.1 Belts

*1998 Utah Crash Facts - Occupant Protection*

Amy Lightfoot

Scope	All occupants of passenger cars and light trucks involved in a motor vehicle crash statewide in Utah in 1998.
Data Used	Crash linked to hospital discharge and emergency department data.
Format	Fact Sheet
Description	This fact sheet provides information regarding belted and unbelted occupants, outlines Utah's seatbelt law in 1998, and gives safety recommendations for car safety seats and safety belts. Highlights include: a comparison of seat belt usage for children (birth to 12) riding with a belted driver and children (birth to 12) riding with an unbelted driver; the number of lives, dollars, hospital stays and emergency department visits that could have been saved if unbelted crash occupants had used a seat belt; percent of unbelted crash occupants by age group; and hospital and fatality information for children ages 1-14 years.
Contact Person	Janet Almond TEL: 801.585.6410 FAX: 801.581.8686 email: janet.almond@hsc.utah.edu

**Management Reports**

*Injury Outcome by Safety Equipment Usage for Persons Involved in Crashes in Maine*

Maine CODES Board of Directors

Scope	All persons involved in 1995 motor vehicle crashes statewide in Maine
Data Used	Crash linked to EMS, hospital, and census data
Format	Management Report
Description	This management report presents by safety equipment usage the total persons involved, total and percent injured, the observed expected ratio, total transported by EMS, hospitalized, hospital days, hospital charges, head injury, fatals, and years of potential life lost. Safety equipment usage is defined as restraining device installed used or not used, not installed, child restraint used, air bags, helmet use, helmet not used, child restraint not used, child restraint used incorrectly, air bag deployed with seat belts used, unknown, not coded.
Contact Person	Cathy St. Pierre TEL: 207.624.5467; FAX: 207.624.5470 email: cathy.s.stpierre@state.me.us

4.3.1 Belts

*Injury Outcome by Position in Vehicle Involved in Crashes in Maine*

Maine CODES Board of Directors

Scope	All persons involved in 1995 motor vehicle crashes statewide in Maine
Data Used	Crash linked to EMS, hospital, and census data
Format	Management Report
Description	This management report presents by position in vehicle the total persons involved, total and percent injured, the observed expected ratio, total transported by EMS, hospitalized, hospital days, hospital charges, head injury, fatals, and years of potential life. Position in vehicle is defined as driver, middle front, right front, left rear, middle rear, right rear, rear compartment, hanging on, MC bike driver, MC bike passenger, MC bike side car hang on, not coded.
Contact Person	Cathy St. Pierre TEL: 207.624.5467; FAX: 207.624.5470 email: cathy.s.stpierre@state.me.us

*Injury Outcome by Number of People in Cars and Light Trucks Involved in Crashes in Maine*

Karl Finison and Gary Menchen

Scope	All persons involved in 1991 motor vehicle crashes statewide in Maine
Data Used	Crash linked to EMS, hospital, and census data
Format	Management Report
Description	This management report presents by number of people in cars and light trucks involved in the crash the total occupants, total injured, percent of total injured, total transported by EMS, total admitted to a hospital, total with severe injury ISS>15, total charges, total with head/spinal injuries, total deaths, years of potential life lost and the relative risk. Number of people in crash and light trucks is defined as 1 occupant, 2 occupants, 3 occupants, 4 occupants, 5+ occupants, unknown/not in vehicle.
Contact Person	Karl Finison TEL: 207.623.2555; FAX: 207.622.7086 email: kfinison@mhic.org

4.3.1 Belts

*Injury Outcome By Type of Ejection for Crashes in Maine*

Maine CODES Board of Directors

Scope	All persons involved in 1995 motor vehicle crashes statewide in Maine
Data Used	Crash linked to EMS, hospital, and census data
Format	Management Report
Description	This management report presents by type of ejection from vehicle, the total persons involved, total and percent injured, the observed expected ratio, total transported by EMS, hospitalized, hospital days, hospital charges, head injury, fatals, and years of potential life lost. Ejection levels are defined as not ejected, partially ejected, ejected, trapped-extricated, not coded.
Contact Person	Cathy St. Pierre TEL: 207.624.5467; FAX: 207.624.5470 email: cathy.s.stpierre@state.me.us

*Injury Outcome for Victims of Motor Vehicle Crashes by Seat Belt Use in 1995 in North Dakota*

Kyle Muus

Scope	All persons involved in motor vehicle crashes that were responded to by EMS in North Dakota during 1995.
Data Used	Crash linked to EMS data
Format	Management Report
Description	This management report presents injury outcomes by seat belt use for persons involved in motor vehicle crashes that were responded to by EMS. Outcome results determined from the crash and EMS data are reported separately by seat belt use. They include total and percent involved in alcohol related crashes, total and percent ejected, percent with 1 or more injuries, total and percent with 1 or more head injuries, total and percent transported by EMS, total and percent with serious injuries (GCS 3-8).
Contact Person	Ann Lunde TEL: 701.328.4397; FAX: 701.328.2435 email: alunde@state.nd.us

4.3.1 Belts

*Injury Outcome for Victims of Motor Vehicle Crashes by Seat Belt Use in 1996 in North Dakota*  
 Kyle Muus

Scope	All persons involved in motor vehicle crashes that were responded to by EMS in North Dakota during 1996.
Data Used	Crash linked to EMS data
Format	Management Report
Description	This management report presents injury outcomes by seat belt use for persons involved in motor vehicle crashes that were responded to by EMS. Outcome results determined from the crash and EMS data are reported separately by seat belt use. They include total and percent involved in alcohol related crashes, total and percent ejected, percent with 1 or more injuries, total and percent with 1 or more head injuries, total and percent transported by EMS, total and percent with serious injuries (GCS 3-8).
Contact Person	Ann Lunde TEL: 701.328.4397; FAX: 701.328.2435 email: alunde@state.nd.us

*Injury Outcome for Victims of Motor Vehicle Crashes by Age Group and Seat Belt Use in 1995 in North Dakota*

Kyle Muus

Scope	Drivers involved in motor vehicle crashes that were responded to by EMS in North Dakota during 1995.
Data Used	Crash linked to EMS data
Format	Management Report
Description	This management report presents injury outcomes by seat belt use and age group (14-19, 20-29, 30-39, 40-49, 50-59, 60-69, 70-79, 80 and higher) for drivers involved in crashes that were responded to by EMS. Outcome results include total and percent involved in alcohol related crashes, total and percent ejected, percent with 1 or more injuries, total and percent with 1 or more head injuries, total and percent transported by EMS, total and percent with serious injuries (GCS 3-8).
Contact Person	Ann Lunde TEL: 701.328.4397; FAX: 701.328.2435 email: alunde@state.nd.us

4.3.1 Belts

*Injury Outcome for Victims of Motor Vehicle Crashes by Age Group and Seat Belt Use in North Dakota*

Kyle Muus

Scope	Drivers involved in motor vehicle crashes that were responded to by EMS in North Dakota during 1996.
Data Used	Crash linked to EMS data
Format	Management Report
Description	This management report presents injury outcomes by seat belt use and age group (14-19, 20-29, 30-39, 40-49, 50-59, 60-69, 70-79, 80 and higher) for drivers involved in crashes that were responded to by EMS. Outcome results include total and percent involved in alcohol related crashes, total and percent ejected, percent with 1 or more injuries, total and percent with 1 or more head injuries, total and percent transported by EMS, total and percent with serious injuries (GCS 3-8).
Contact Person	Ann Lunde TEL: 701.328.4397; FAX: 701.328.2435 email: alunde@state.nd.us

*Injury Outcome for Victims of Motor Vehicle Crashes by Race and Seat Belt Use in 1995 in North Dakota*

Kyle Muus

Scope	Caucasians and Native Americans involved in motor vehicle crashes that were responded to by EMS in North Dakota during 1995.
Data Used	Crash linked to EMS data
Format	Management Report
Description	This management report presents injury outcomes by seat belt use for Caucasians and Native Americans involved in motor vehicle crashes that were responded to by EMS. Outcome measures determined from the crash and EMS data are reported separately by seat belt use for each race group. They include total and percent involved in alcohol related crashes, total and percent ejected, percent with 1 or more injuries, total and percent with 1 or more head injuries, total and percent transported by EMS, total and percent with serious injuries (GCS 3-8).
Contact Person	Ann Lunde TEL: 701.328.4397; FAX: 701.328.2435 email: alunde@state.nd.us

4.3.1 Belts

*Injury Outcome for Victims of Motor Vehicle Crashes by Race and Seat Belt Use in North Dakota*

Kyle Muus

Scope	Caucasians and Native Americans involved in motor vehicle crashes that were responded to by EMS in North Dakota during 1996.
Data Used	Crash linked to EMS data
Format	Management Report
Description	This management report presents injury outcomes by seat belt use for Caucasians and Native Americans involved in motor vehicle crashes that were responded to by EMS. Outcome measures determined from the crash and EMS data are reported separately by seat belt use for each race group. They include total and percent involved in alcohol related crashes, total and percent ejected, percent with 1 or more injuries, total and percent with 1 or more head injuries, total and percent transported by EMS, total and percent with serious injuries (GCS 3-8).
Contact Person	Ann Lunde TEL: 701.328.4397; FAX: 701.328.2435 email: alunde@state.nd.us

*Injury Outcome for Victims of Motor Vehicle Crashes by Vehicle Seating Position and Seat Belt Use in 1995 in North Dakota*

Kyle Muus

Scope	Drivers, front seat passengers, back seat passengers involved in motor vehicle crashes that were responded to by EMS in North Dakota in 1995.
Data Used	Crash linked to EMS data
Format	Management Report
Description	This management report presents injury outcomes by seat belt use for drivers, front seat passengers and back seat passengers involved in motor vehicle crashes that were responded to by EMS. Outcome measures determined from the crash and EMS data are reported separately by seat belt use for drivers, front seat passengers and back seat passengers. They include total and percent involved in alcohol related crashes, total and percent ejected, percent with 1 or more injuries, total and percent with 1 or more head injuries, total and percent transported by EMS, total and percent with serious injuries (GCS 3-8).
Contact Person	Ann Lunde TEL: 701.328.4397; FAX: 701.328.2435 email: alunde@state.nd.us

4.3.1 Belts



*Injury Outcome for Victims of Motor Vehicle Crashes by Vehicle Seating Position and Seat Belt Use in North Dakota*

Kyle Muus

Scope	Drivers, front seat passengers, back seat passengers involved in motor vehicle crashes that were responded to by EMS in North Dakota in 1996.
Data Used	Crash linked to EMS data
Format	Management Report
Description	This management report presents injury outcomes by seat belt use for drivers, front seat passengers and back seat passengers involved in motor vehicle crashes that were responded to by EMS. Outcome measures, determined from the crash and EMS data, include total and percent involved in alcohol related crashes, total and percent ejected, percent with 1 or more injuries, total and percent with 1 or more head injuries, total and percent transported by EMS, total and percent with serious injuries (GCS 3-8).
Contact Person	Ann Lunde TEL: 701.328.4397; FAX: 701.328.2435 email: alunde@state.nd.us

*Injury Outcome for Victims of Motor Vehicle Crashes by Metro/Non-Metro Location of Occurrence and Seat Belt Use in 1995 in North Dakota*

Kyle Muus

Scope	All persons involved in motor vehicle crashes that were responded to by EMS in Metro (MSA area) and Non-metro (non-MSA area) locations in North Dakota during 1995.
Data Used	Crash linked to EMS data
Format	Management Report
Description	This management report presents injury outcomes by seat belt use for all persons involved in motor vehicle crashes that were responded to by EMS in Metro (MSA area) and Non-metro (non-MSA area) locations. Outcome measures include total and percent involved in alcohol related crashes, total and percent ejected, percent with 1 or more injuries, total and percent with 1 or more head injuries, total and percent transported by EMS, total and percent with serious injuries (GCS 3-8).
Contact Person	Ann Lunde TEL: 701.328.4397; FAX: 701.328.2435 email: alunde@state.nd.us

4.3.1 Belts

*Injury Outcome for Victims of Motor Vehicle Crashes by Metro/Non-Metro Location of Occurrence and Seat Belt Use in 1996 in North Dakota*

Kyle Muus

Scope	All persons involved in motor vehicle crashes that were responded to by EMS in Metro (MSA area) and Non-metro (non-MSA area) locations in North Dakota during 1996.
Data Used	Crash linked to EMS data
Format	Management Report
Description	This management report presents injury outcomes by seat belt use for all persons involved in motor vehicle crashes that were responded to by EMS in Metro (MSA area) and Non-metro (non-MSA area) locations. Outcome measures include total and percent involved in alcohol related crashes, total and percent ejected, percent with 1 or more injuries, total and percent with 1 or more head injuries, total and percent transported by EMS, total and percent with serious injuries (GCS 3-8).
Contact Person	Ann Lunde TEL: 701.328.4397; FAX: 701.328.2435 email: alunde@state.nd.us

*Effect of Seating Position and Restraint Use on Injuries to Children in Motor Vehicle Crashes in Utah*

Marc D. Berg, Lawrence J. Cook, Howard M. Corneli, Donald D. Vernon, J. Michael Dean

Scope	Children involved in motor vehicle crashes statewide in Utah 1992-1996.
Data Used	Crash linked to inpatient hospital discharge data
Format	Study
Description	This study presents the effect of seatbelt or child restraint use and seating position on injuries to children in motor vehicle crashes. It discusses the impact of whether sitting in the rear seat during a serious crash provided protection to the child occupant after allowing for the use of an age-appropriate restraint device
Contact Person	Janet Almond TEL: 801.585.6410 FAX: 801.581.8686 email: janet.almond@hsc.utah.edu

4.3.1 Belts

### *Death and Hospitalization by Belt Use in Wisconsin*

Wayne Bigelow

Scope	Occupants of automobiles, light trucks and vans for whom age was present involved in 1996 crashes in Wisconsin
Data Used	Crash data linked to inpatient hospital discharge data.
Format	Management Report
Description	This management report presents the total occupants, total injured, total and percent fatalities by age group for belted and non-belted occupants. Age group is defined as: <5 years, 5-18 years, 19-64 years, 65-74 years, 75 years and greater, unknown. Belted is defined as anyone for whom either use of a child restraint, lap belt or a shoulder belt is indicated. Other persons for whom restraint use is unknown had their cases and charges reallocated proportionately across the belted and non-belted groups. Died is defined as either a death documented on the crash report or the inpatient hospital discharge data file. Hospitalized includes only those inpatients matched to a crash record.
Contact Person	Martha Florey TEL: 608.266.3557; FAX: 608.267.0441 email: mflorey@mail.state.wi.us

### **4.3.2 Child Safety Seats**

#### **Studies**

#### *Child Safety Seat Effectiveness in Pennsylvania*

Michael Allen and Harold (Hank) Weiss

Scope	Child (under age four) occupants of passenger cars and light trucks involved in 1994 crashes statewide in Pennsylvania
Data Used	Crash linked to EMS and inpatient hospital discharge data statewide
Format	Study
Description	This study reports on the effectiveness of child safety seats in reducing total and average hospital costs, mortality, and morbidity from motor vehicle crashes. Child safety seats are evaluated in terms of reduced mortality, injury and hospital charges. Co-variates that are controlled include seat position, age, sex, type of vehicle and type of crash.
Contact Person	Hank Weiss TEL: 412.648.9290; FAX: 412.648.8924 email: hweiss@injurycontrol.com

4.3.2 Safety Seats

### 4.3.3 Helmet Utilization

#### Studies

##### *Head Injuries Associated with Motorcycle Use in Wisconsin*

Trudy Karlson and Charles Quade

Scope	All riders involved in 1991 motorcycle crashes statewide
Data Used	Crash linked to hospital data
Format	Study
Description	This study uses linked crash and hospital data to evaluate the effect of motorcycle helmet use on specific brain injuries. Brain injuries are defined from ICD-9-CM codes to include all cases indicating intracranial injury.
Contact Person	Martha Florey TEL: 608.266.3557; FAX: 608.267.0441 email: mflorey@mail.state.wi.us

##### *Injuries and Costs Associated with Failure to Use Motorcycle Helmets in Missouri*

Mark Van Tuinen

Scope	All riders involved in 1990 motorcycle crashes statewide in Missouri
Data Used	Crash linked to EMS, emergency department, hospital and insurance claims data
Format	Study
Description	This study presents Missouri specific results of the effectiveness of motorcycle helmets on injuries and costs.
Contact Person	Mark Van Tuinen TEL: 573.751.6274; FAX: 573.526.4102 email: vantum@mail.health.state.mo.us

#### 4.3.4 Alcohol and Drug Use

##### Studies

###### *Motor Vehicle Crashes Involving Alcohol Impairment in 1995-1996 and Their Outcomes Statewide in Oklahoma*

Ross Clarke

Scope	All occupants involved in 1995-1996 police reported motor vehicle crashes statewide in Oklahoma.
Data Used	Crash linked to EMS and inpatient hospital discharge data.
Format	Study
Description	This study presents data indicating the level of police reported severity (KABCO), percent of drivers who died or were incapacitated, average and total inpatient charges and average inpatient charges are reported by alcohol impairment (alcohol, no alcohol, drugs, unknown) using several tables. In addition, the percent of drivers involved in crashes who were alcohol-impaired are reported by county. Data are reported separately for 1995-1996.
Contact Person	Ross Clarke TEL 405.271.3407; FAX: 405.271.3397 email: ross-clarke@ouhsc.edu

##### Management Reports

###### *Injury Outcome in Alcohol-Related Crashes in Maine*

Karl Finison and Gary Menchen

Scope	All persons involved in 1991 motor vehicle crashes statewide in Maine
Data Used	Crash linked to EMS, hospital, and census data
Format	Management Report
Description	This management report presents the injury outcome for alcohol and non-alcohol related crashes including the total occupants, total injured, total transported by EMS, total admitted to a hospital, total with severe injury ISS>15, total charges, total with head/spinal injuries, total deaths, total years of potential life lost, and relative risk of injury.
Contact Person	Karl Finison TEL: 207.623.2555; FAX: 207.622.7086 email: kfinison@mhic.org

4.3.4 Alcohol

*Injury Outcome for Pedestrians/Bicyclists Involved in Alcohol Related Crashes by Apparent Physical Condition of Driver in Maine*

Karl Finison and Gary Menchen.

Scope	All persons involved in 1991 motor vehicle crashes statewide in Maine
Data Used	Crash linked to EMS, hospital, and census data
Format	Management Report
Description	This management report presents for pedestrians/bicyclists involved in alcohol related crashes by apparent physical condition of the driver the injury outcome including the total involved, total injured, percent of total injured, total transported by EMS, total admitted to a hospital, total with severe injury ISS>15, total charges, total with head/spinal injuries, total deaths and total years of potential life lost. Data are reported by apparent physical condition of the driver. Apparent physical condition is defined as normal, under the influence, had been drinking, had been using drugs, asleep, fatigued, ill, handicapped, other, missing/invalid.
Contact Person	Karl Finison TEL: 207.623.2555; FAX: 207.622.7086 email: kfinison@mhic.org

*Injury Outcome by Apparent Physical Condition of Driver in Single Vehicle Crashes in Maine*

Karl Finison and Gary Menchen.

Scope	All persons involved in 1991 motor vehicle crashes statewide in Maine
Data Used	Crash linked to EMS, hospital, and census data
Format	Management Report
Description	This management report presents by apparent physical condition for driver in single vehicle crash including the total occupants, total injured, percent of total injured, total transported by EMS, total admitted to a hospital, total with severe injury ISS>15, total charges, total with head/spinal injuries, total deaths and total years of potential life lost. Apparent physical condition is defined as normal, under the influence, had been drinking, had been using drugs, asleep, fatigued, ill, handicapped, other, missing/invalid.
Contact Person	Karl Finison TEL: 207.623.2555; FAX: 207.622.7086 email: kfinison@mhic.org

4.3.4 Alcohol

### 4.3.5 Speed

#### *Motor Vehicle Crashes in 1995-1996 by Speed Limit at Crash Site and Their Outcomes Statewide in Oklahoma*

Ross Clarke

Scope	All occupants involved in 1995-1996 police reported motor vehicle crashes statewide in Oklahoma.
Data Used	Crash linked to EMS and inpatient hospital discharge data.
Format	Study
Description	Percent of drivers who died or were inpatients, level of police reported severity (KABCO), average inpatient charges, and average and total inpatient charges are arrayed by speed limit at crash site (15-25, 30-50, 55 and above) using several tables. In addition, percent of crashes at high speed (55-65) are reported by county. Data are reported separately for 1995-1996.
Contact Person	Ross Clarke TEL: 405.271.3407; FAX: 405.271.3397 email: ross-clarke@ouhsc.edu

### 4.3.6 Driver Licensing

#### **Studies: All Drivers**

#### *Evaluating Drivers Licensed with Medical Conditions in Utah, 1992-1996*

Donald D. Vernon, Lawrence J. Cook, Edna Diller, James C. Reading

Scope	All persons involved in 1992-1996 motor vehicle crashes statewide in Utah
Data Used	Crash data and death certificates linked to master driver license file
Format	Study
Description	This study evaluates the crash and citation rates of drivers in the medical conditions drivers program in Utah, compared with age- and location- matched controls. Medical conditions drivers fell into two groups: those who had driver license restrictions (time of day, roads, or locations) and those who had no restrictions. A limitation of the study and the program is that the medical conditions program is voluntary, relying on drivers to identify themselves as having medical conditions.
Contact Person	Janet Almond TEL: 801.585.6410 FAX: 801.581.8686 email: janet.almond@hsc.utah.edu

4.3.5 Speed/4.3.6 Licensing

### Studies: Young Drivers

#### *Comparison of Young and Adult Driver Crashes in Alaska Using Linked Traffic Crash and Hospital Data*

Martha Moore

Scope	Drivers involved in 1991-1995 crashes statewide in Alaska
Data Used	Crash linked to trauma registry data that include all injuries statewide admitted to a hospital, transferred to another acute care facility, or declared dead in the ED.
Format	Study
Description	This study examines the role of youth and inexperience (drivers age 16 through 20) in motor vehicle crashes, the contributing factors of crashes involving drivers from this age group, the medical outcomes of crashes involving youth and the costs associated with these crashes (including the payers of these costs). Data for the young drivers are compared to adult drivers aged 21-50 years. The goal of the project is to use linked data to enact a graduated licensing law in Alaska in order to reduce death, disability, and costs for drivers aged 16-20.
Contact Person	Martha Moore TEL: 907.465.8631; FAX: 907.465.4101 email: mmoore@health.state.ak.us

#### *Analysis of Crashes Involving Young Adults in Maine*

Karl Finison and Robert B. DuBrow

Scope	Occupants of passenger cars and light trucks involved in 1996 police reported motor vehicle crashes statewide in Maine
Data Used	Crash linked to EMS, hospital discharge, death certificate and driver licensing data
Format	Study
Description	This study uses bivariate tables and multivariate logistic analyses. Drivers and passengers are analyzed separately. Independent variables for the driver include license status (suspended), alcohol related, illegal/unsafe speed, driver inexperience, overtaking/passing, seat belt use, and driver's sex. Crash factors include time of day (8 PM to 4 AM), location (rural vs urban), posted speed limit (as reported by police), intersection crash, turning movement, and multi-vehicle crash. Drivers 16-24 are compared to drivers age 25-69. The dependent variables are defined as: any injury; any EMS transport, hospital discharge or death; any hospital discharge or death; any hospital discharge or death with any ICD-9-CM code indicating a head injury; or any death.
Contact Person	Cathy St. Pierre TEL: 207.624.5467; FAX: 207.624.5470 email: cathy.s.stpierre@state.me.us

4.3.6 Licensing



*Motor Vehicle Traffic Crash Outcome Involving Teen Drivers in Nebraska in 1996-1997*

Ming Qu and Dan Christensen

Scope	All drivers aged 14-19 years in Nebraska in 1996-1997.
Data Used	Crash linked to hospital data
Format	Study
Description	Motor vehicle traffic crash outcome for teen drivers is examined using CODES data for 1996-1997. Descriptive statistics and multivariate logistic analyses are utilized. The outcome measurements are injury, death, and hospital charges. The variables analyzed include demographic (age, gender, and crash location), driver behavior (i.e. alcohol use, safety belt use, and other improperly driving or violation), and crash factors (crash time, type of crash). Prevention recommendations are discussed.
Contact Person	Ming Qu TEL: 402.471.0566; FAX: 402.471.6436 Email: ming.qu@hss.state.ne.us

*Motor Vehicle Crashes Involving Young Drivers (16-17) in 1995-1996 and Their Outcomes Statewide in Oklahoma*

Ross Clarke

Scope	All occupants involved in 1995-1996 police reported motor vehicle crashes statewide in Oklahoma.
Data Used	Crash linked to EMS and inpatient hospital discharge data.
Format	Study
Description	Level of police reported severity (KABCO), percent of drivers who died or were inpatients, average and total inpatient charges, average inpatient charges, safety belt use, and total night time crashes are arrayed by age group (16-17, 18 and above, unknown) using several tables. In addition, percent of crashes with drivers 16-17 are reported by county. Data are reported separately for 1995-1996.
Contact Person	Ross Clarke TEL 405.271.3407; FAX: 405.271.3397 email: ross-clarke@ouhsc.edu

4.3.6 Licensing

*A Population-Based Study of Teenage Drivers: 1992-1996 in Utah*

Natalie Z. Cvijanovich, Lawrence J. Cook, Patricia J. Nechodom, J. Michael Dean

Scope	All drivers involved in motor vehicle crashes 1992-1996
Data Used	Crash linked to emergency department and inpatient hospital discharge data
Format	Study
Description	This study determines the population-based rate of motor vehicle crashes involving teenage drivers in a single state, the characteristics of the crashes, and actual hospital charges associated with all people involved in those crashes in order to determine the potential effectiveness of interventions aimed at teenage drivers, such as graduated driver licensing programs.
Contact Person	Janet Almond TEL: 801.585.6410 FAX: 801.581.8686 email: janet.almond@hsc.utah.edu

*Adults and Children in Severe Motor Vehicle Crashes: A Matched-Pairs Study in Utah.*

Howard M. Corneli, Lawrence J. Cook, J. Michael Dean

Scope	413 adult-child pairs formed from all persons in 1992-1996 motor vehicle crashes in Utah
Data Used	Crash linked to EMS, emergency department and hospital data
Format	Study
Description	This study examines the effects of adult versus child age, seat belt use, and seating position on outcome in motor vehicle crashes. A population-based data set of all motor vehicle crashes statewide is analyzed by matched-pairs logistic regression. Subjects are occupants of motor vehicle crashes in which at least one occupant was killed or hospitalized and at least one is a child (age <15). Unique matched pairs are formed of one adult and one child from the same vehicle. The main outcome measure is death or hospitalization. Co variates are seat belt use and front or back seat position. Intervention strategies are discussed.
Contact Person	Janet Almond TEL: 801.585.6410 FAX: 801.581.8686 email: janet.almond@hsc.utah.edu

4.3.6 Licensing

### Studies: Older Driver

#### *An Evaluation of Motor Vehicle Crashes Involving Elderly Drivers in Connecticut*

Gerald Zuckier, Lenworth Jacobs, Lorna Thibeault

Scope	All persons involved in 1995 crashes statewide in Connecticut
Data Used	Crash data linked to a linked data file including emergency department, ambulatory surgery, hospital discharge, death certificate data.
Format	Study
Description	Multiple logistic regression with backward stepwise selection is used to identify crash characteristics associated with elderly drivers. Outcome variables include frequency of elderly drivers in motor vehicle crashes, injury status, length of stay, total hospital charge, mortality, severity of injury. Independent variables include age, gender, location of the crash, fixed object struck, speeding, following too closely, violating traffic controls, unsafe use of highway by pedestrian, driver illness, construction, road surface, snow, rain, drinking status of driver, lighting conditions, type of motor vehicle, collision type, and injury classification. Connecticut linked these data using a deterministic algorithm prior to CODES funding.
Contact Person	Gerald Zuckier TEL: 203.294.7354; FAX: 203.284.9318 email: zuckier@chime.org

#### *Older Drivers: Crashes, Injuries, Outcomes in Maryland*

Patricia C. Dischinger, Joseph A. Kufera, Shiu M. Ho

Scope	Hospitalized drivers involved in crashes of automobiles, light trucks, and vans in Maryland for the years 1995-1996
Data Used	Crash report linked to inpatient hospital discharge data
Format	Study
Description	This study compares drivers aged 65 and greater to those less than 65 by crash, injury and outcome characteristics. The variables analyzed include: gender, day and time of crash, weather, type of crash, point of impact, seat belt used, airbag, culpability, medical conditions, body region, injury severity score, length of stay, hospital cost, and hospital disposition.
Contact person	Patricia C. Dischinger TEL: 410.328.4246; FAX: 410.328.3699 email: pdischin@nsc.ummc.umaryland.edu

4.3.6 Licensing

*Hospitalized Driver's Injuries by Age Group: a Focus on Older Drivers in New York*

Joanne Guardino

Scope	All persons involved in 1992 motor vehicle crashes statewide in New York
Data Used	Crash linked to EMS and inpatient hospital discharge data
Format	Study
Description	This study evaluates the increased risk for injury from a motor vehicle crash by age group, particularly the elderly population. All drivers are assigned to groups covering a span of 10 years (16-24, 25-34, etc.). Factors, such as speed, contributing to the crash, use of protective devices are considered. Type of injury, length of stay, and hospital charges are compared for each age group.
Contact Person	Anne Dowling TEL: 518.453.0291; FAX: 518.453.0298 adowling@global2000.net

*Crashes Involving Older Drivers in New York*

Ann Dowling

Scope	All persons involved in 1994 motor vehicle crashes statewide in New York
Data Used	Crash linked to EMS and inpatient hospital discharge data
Format	Study
Description	This study provides information about the impact of driver age on the type/severity of injuries and medical costs after consideration of safety equipment and vehicle type. Severity is measured using ICD-9-CM, AIS, and ISS scores.
Contact Person	Anne Dowling TEL: 518.453.0291; FAX: 518.453.0298 adowling@global2000.net

4.3.6 Licensing

*Motor Vehicle Crash characteristics and Medical Outcomes Among Older Drivers 1992-1995.*  
Lawrence J. Cook, Stacey Knight, Lenora M. Olson, Patricia J. Nechodom, J. Michael Dean

Scope	All persons involved in motor vehicle crashes statewide in Utah 1992-1996.
Data Used	Crash linked to inpatient hospital discharge data
Format	Study
Description	The impact of older persons on the roadways was evaluated by comparing motor vehicle crashes involving drivers age 70 years and over with those involving drivers between the ages of 30 to 39 years. This study uses linked statewide motor vehicle crash and inpatient hospital discharge data from Utah for the years 1992-1995 for the purpose of providing information for designing, implementing, and evaluating countermeasures that may enable older drivers to continue driving while keeping public safety in the forefront.
Contact Person	Janet Almond TEL: 801.585.6410 FAX: 801.581.8686 email: janet.almond@hsc.utah.edu

### Fact Sheets

*Alaska Youth Traffic Safety: Fact Sheet*  
Martha Moore

Scope	Persons aged 16-20 involved in 1991-1995 crashes statewide in Alaska
Data Used	Crash linked to Trauma Registry (includes all injuries statewide that are admitted to a hospital, transferred to another acute care facility, or declared dead in the ED).
Format	Fact Sheet
Description	This fact sheet compares 1995 national data for ages 15-20 with 1991-1995 Alaskan data for ages 16-20. The format includes results generated from linked crash and injury data.
Contact Person	Martha Moore TEL: 907.465.8631; FAX: 907.465.4101 email: mmoore@health.state.ak.us

4.3.6 Licensing

*Young Drivers, Maine Crash Facts, 1996*

Karl Finison and Robert B. DuBrow

Scope	Occupants of passenger cars and light trucks involved in 1996 police reported motor vehicle crashes statewide in Maine
Data Used	Crash linked to EMS, hospital discharge, death certificate and driver licensing data
Format	Fact Sheet
Description	This fact sheet presents tables indicating driver injury rates by age (16, 17, 28, 19, 20, 21, 22, 23, 24, 25-29, 30-34, 35-39, 40-44, 45-49, 50-54, 55-59, 60-64, 65-69, 70 and above. Outcome is reported as total injured, transported by EMS, hospitalized, hospital days, hospital charges, died, and years of potential life lost. Payment of inpatient hospital charges for Maine drivers age 16-24 are reported by insured, no insurance and Medicaid. Drivers involved in alcohol-related crashes per 100,000 licensed drivers are reported by age group as listed above.
Contact Person	Cathy St. Pierre TEL: 207.624.5467; FAX: 207.624.5470 email: cathy.s.stpierre@state.me.us

*Utah Crash Fact Sheet - Graduated Driver Licensing*

Amy Lightfoot

Scope	All occupants of passenger cars and light trucks involved in a motor vehicle crash statewide in Utah in 1992-1996.
Data Used	Crash linked to inpatient hospital discharge data
Format	Fact Sheet
Description	This fact sheet is designed to provide information about crashes involving 15-17 year old drivers. Inpatient hospital discharge data highlights include: citations issued to 15-17 year old drivers; the effect of the age and number of passengers riding with 15-17 year old drivers (specifically relating to citations, seat belts, hospitalizations and fatalities); seat belt usage of 15-17 year old drivers; and hospital inpatient charges incurred by occupants of vehicles driven by 15-17 year olds.
Contact Person	Janet Almond TEL: 801.585.6410 FAX: 801.581.8686 email: janet.almond@hsc.utah.edu

4.3.6 Licensing

### 4.3.7 Tourists

#### Study

*Tourist collisions in Hawaii*

Karl Kim

Scope	Out-of-state drivers involved in motor vehicle crashes in 1998-1996 in Hawaii
Data Used	Crash linked to EMS and hospital data for 1990
Format	Study
Description	This presentation includes descriptive information about tourist collisions in Hawaii. Tourist crashes are mapped geographically to display location of those requiring EMS transport and those requiring hospitalization.
Contact Person	Karl Kim TEL: 808.956.7381; FAX: 808.956.6870 email: karlk@hawaii.edu

### 4.4 Law Enforcement

#### 4.4.1 Public Education and Planning

#### Study

*Marketing CODES as a Public Education and Planning Tool for Law Enforcement*

Thomas Hettinger

Scope	All persons involved in 1993-1997 police reported motor vehicle crashes statewide in New Hampshire; also.
Data Used	Crash data for 1993-1997 and 1996 linked "crash/emergency department/inpatient hospital discharge data
Format	Study
Description	This study, prepared for the New Hampshire Association of Chiefs of Police, presents general crash characteristics (frequency by day of week, time, type of crash, total injuries by police reported severity (KABCO) level, alcohol/drug involvement, non-residents) using crash data for 1993-1997. Linked data for 1996 are used to assign costs for specific characteristics: driver condition (normal, alcohol/drugs, asleep/medical problem, unknown), need for hospitalization, and restraint use.
Contact Person	Martin Singer TEL: 603.271.4569; FAX: 603.271.4567 msinger@dhhs.state.nh.us

4.4 Law

## 5.0 APPLICATIONS FOR HIGHWAY SAFETY

### 5.1 Roadway

#### 5.1.1 Objects in Roadway

##### Studies

*An Evaluation of Severity and Outcome of Injury by Type of Object Struck (First Object Struck Only) for Motor Vehicle Crashes in Connecticut*

Gerald Zuckier, Lenworth Jacobs, Lorna Thibeault

Scope	All persons involved in 1995 crashes in Connecticut
Data Used	Crash data linked to a linked data file including emergency department, ambulatory surgery, hospital discharge, death certificate data.
Format	Study
Description	A multiple logistic regression with backward stepwise selection is used for the analysis. Outcome is defined as the frequency of first object struck, mortality, total charges, length of stay and the Injury Severity Score (ISS). Independent variables include age, gender, location of the crash, location of fixed object struck, speeding, following too closely, violating traffic controls, unsafe use of highway by pedestrian, driver illness, construction, road surface, snow , rain, drinking status of driver and , lighting conditions, type of motor vehicle, collision type, and injury classification. The linkage process, based on a deterministic algorithm, was performed prior to Connecticut's CODES funding.
Contact Person	Gerald Zuckier TEL: 203.294.7354; FAX: 203.284.9318 email: zuckier@chime.org

5.1 Objects



*Modeling the Causes and Consequences of Collisions With Utility Poles in Hawaii*

Karl Kim and Lei Li

Scope	All persons involved in motor vehicle crashes occurring between 1990-1991 in Hawaii. Also includes unlinked crash data for ten year period 1986-1995.
Data Used	Crash data linked to EMS , hospital and medical insurance claims data.
Format	Study
Description	This study describes the characteristics of drivers, roadway and environmental features of utility pole collisions and their medical and financial outcomes utilizing linked data. Utility pole collisions are compared to vehicle-to-vehicle collisions in terms of the probability of injury using various injury scores (KABCO, ISS, AIS), and average hospital costs. Utility pole collisions are found to be more serious in terms of injury level than vehicle-to-vehicle crashes. A logistic model is used to estimate the odds of being injured in utility pole collisions. Injury is evaluated in terms of age, gender, belt use, alcohol/drugs, speed, and other characteristics. Recommendations for reducing utility pole collisions involving engineering, enforcement, and education approaches are included.
Contact Person	Karl Kim TEL: 808.956.7381; FAX: 808.956.6870 email: karlk@hawaii.edu

*Crashes Involving Collisions With Fixed Objects in New York*

Ann Dowling

Scope	All persons involved in 1992-1996 motor vehicle crashes statewide in New York
Data Used	Crash data for 1992-1996; Crash data linked to EMS, hospital discharge data, and highway data for 1992
Format	Study
Description	This study uses type of crash, rural/urban location, time of day, type of object struck, restraint use, type and location of injury seating position, single/multiple vehicle involvement, age, gender, type of road, number of lanes, shoulder width, total and average charge for hospitalization and length of stay to evaluate fixed object crashes in New York. Type of crash includes single vehicle/single event. Fixed objects include utility pole, tree, guide rail, earth embankment, ditch, and rock cut.
Contact Person	Anne Dowling TEL: 518.453.0291; FAX: 518.453.0298 adowling@global2000.net

5.1 Objects

*Using Linked Data to Evaluate Crashes Involving Fixed Objects in Pennsylvania*

Michael Allen & Harold (Hank) Weiss

Scope	All persons involved in 1994 single vehicle fixed object crashes on high speed state and Federal highways statewide in Pennsylvania
Data Used	Crash data used to define the fixed objects and crash circumstances; Crash/EMS/Hospital data used to define injury severity; Hospital data to define costs.
Format	Study
Description	This study focuses on the injury risks posed by trees and utility poles in Pennsylvania. Injury outcome is measured in terms of the risk of death, major injury, hospital charges and vehicle deformation.
Contact Person	Hank Weiss TEL: 412.648.9290; FAX: 412.648.8924 email: hweiss@injurycontrol.com

**Fact Sheets**

*Total Occurrences and Total and Average Hospital Charges by Collision with Another Object in Iowa*

Dick Harmon

Scope	Persons injured and hospitalized as a result of a motor vehicle collision with another object in 1996 in Iowa.
Data Used	Crash linked to inpatient hospital discharge data
Format	Fact Sheet
Description	This fact sheet reports the persons involved in motor vehicle collision and their total hospital inpatient charges. A bar chart displays the total persons injured and hospitalized for each of 10 types of motor vehicle collisions. A graph displays the total and average hospital charges for the same groups.
Contact Person	Dick Harmon TEL: 515.281.5737; FAX: 515.281.4958 email: dharmon@health.state.ia.us

*Fixed Object Crashes: The Top Six by Frequency of Occurrence, the Top Six by Average Hospital Charges, and their Geographic Locations for Persons Hospitalized As a Result of a Fixed Object Motor Vehicle Crash in Iowa.*

Dick Harmon

Scope	Persons injured requiring hospitalization as the result of a fixed object crash during 1996 in Iowa
Data Used	Crash linked to inpatient hospital discharge data
Format	Fact Sheet
Description	This fact sheet presents the total hospital charges for 721 persons injured and hospitalized as the result of a fixed object crash. Two bar charts are displayed. The first presents the total hospitalized victims by type of fixed object for each of the six most frequent occurrences. The second displays the average hospital charge by type of fixed object for the six most expensive occurrences. Also included is a map displaying the location of the fixed object crashes for this group.
Contact Person	Dick Harmon TEL: 515.281.5737; FAX: 515.281.4958 email: dharmon@health.state.ia.us

### Management Reports

*Injury Outcome for Crashes Involving Moose, Deer or Other/Unknown in Maine*

Karl Finison and Gary Menchen.

Scope	All persons involved in 1991 motor vehicle crashes statewide in Maine
Data Used	Crash linked to EMS, hospital and Department of Inland and Fisheries and Wildlife data
Format	Management Report
Description	This management report indicates for persons in crashes involving an animal total occupants involved in the crash, total injured, total transported by EMS, total admitted to a hospital, percent of the total injured, and the average hospital charge. Animal type is defined as moose, deer, and other.
Contact Person	Karl Finison TEL: 207.623.2555; FAX: 207.622.7086 email: kfinison@mhic.org

5.1 Objects

## 5.1.2 Crash Analysis by Roadway

### Studies

#### *1995 Loudon Road Crash Study for Concord Police Department in New Hampshire*

Tom Hettinger

Scope	All persons involved in 1995 crashes that occurred on Loudon Road in Concord, New Hampshire.
Data Used	Crash data linked to EMS and emergency department data.
Format	Study
Description	This study provides an in depth analysis of the characteristics of crashes that occurred on Loudon Road in Concord, New Hampshire during 1995. Linked data are used to calculate the average emergency department charge for all injuries treated, for victims using restraints/helmets and for those not using them.
Contact Person	Tom Hettinger TEL: 603.271.0322; FAX: 603.271.4567 email: thetting@dhhs.state.nh.us

#### *Loudon Road Update of Crash Study for Concord Police Department in New Hampshire*

Tom Hettinger

Scope	All persons involved in crashes that occurred in 1997-1998 on Loudon Road in Concord, New Hampshire.
Data Used	Crash data linked to EMS and emergency department data.
Format	Study
Description	This study updates the 1995 analysis of the characteristics of crashes that occurred on Loudon Road in Concord, New Hampshire. Linked data for 1997-1998 are used to calculate the average emergency department charge for all injuries treated, for victims using restraints/helmets and for those not using them.
Contact Person	Tom Hettinger TEL: 603.271.0322; FAX: 603.271.4567 email: thetting@dhhs.state.nh.us

## 5.1.2 Crash & Roadway

## 6.0 APPLICATIONS FOR EMS

### 6.1 Occurrence of EMS Transports

#### Studies

*Geographic Information System for Emergency Medical Services Analysis in Hawaii*

Lawrence Nitz, Karl E. Kim, Donna Maiava

Scope	All persons involved in 1990 motor vehicle crashes in Hawaii
Data Used	Crash linked to EMS, emergency department, hospital and insurance claims data
Format	Study
Description	Mapping and spatial data sources are described in the context of the analysis of location characteristics of EMS runs. The study presents point, segment, and areal aspects of EMS call for young drivers, motorcyclists, victims of utility pole and bus/pedestrian crashes and cardiac emergencies that have application to EMS and transportation policy planning.
Contact Person	Karl Kim TEL: 808.956.7381; FAX: 808.956.6870 email: karlk@hawaii.edu

6.1 EMS

*Characterization of EMS Transports Related to Motor Vehicle Crashes in Utah, 1991*

J. Michael Dean, Pat Nechodom, Donald D. Vernon, Larry Cook, Jim Reading

Scope	All persons involved in 1991 motor vehicle crashes statewide in Utah
Data Used	Crash linked to EMS, emergency department and inpatient hospital discharge data
Format	Study
Description	This study describes EMS transports from motor vehicle crashes in Utah during 1991 by mode of emergency transport, including transported without paramedics, by single paramedic unit, by double paramedic unit, by helicopter, etc. Averages are presented for age, Glasgow Coma Scale, CRAMS score, length of stay, and hospital inpatient/outpatient charges by transport type. Total EMS transports are presented 5 year age groups by transport type. Similar information is presented for outpatient and inpatient care recipients. The study also presents county-based data including percentage of EMS linkages and incidence rates of crashes.
Contact Person	Janet Almond TEL: 801.585.6410 FAX: 801.581.8686 email: janet.almond@hsc.utah.edu

*Evaluation of Emergency Medical Services: Probabilistic Linkage of Computerized Ambulance and Inpatient Hospital Discharge Records in Utah*

J. Michael Dean, Donald D. Vernon, Lawrence J. Cook, Patricia Nechodom, James C. Reading, Anthony Suruda

Scope	All individuals transported by EMS from 1994 through 1996 who had computerized ambulance records.
Data Used	EMS linked to inpatient hospital discharge data
Format	Study
Description	This study demonstrates the feasibility of linking ambulance records and inpatient hospital discharge records using probabilistic linkage. The linked data are useful for evaluating emergency medical services on a statewide basis. The study links a patient's EMS status to inpatient outcome permitting an assessment of outcome by dispatch codes, ages, injury status, etc.
Contact Person	Janet Almond TEL: 801.585.6410 FAX: 801.581.8686 email: janet.almond@hsc.utah.edu

6.1 EMS

## Management Reports

### *EMS Response Times by Population Density in Maine*

Karl Finison and Gary Menchen

Scope	All persons involved in 1987 and 1991 motor vehicle crashes statewide in Maine
Data Used	Crash linked to EMS, hospital, and census data
Format	Management Report
Description	This management report presents for specific EMS times (access, response, destination, total) the total EMS transports related to motor vehicle crashes, the average time by population density. Population density per square mile is defined as metro (>500), urban (101-500), suburban (51-100), rural (7-50), wilderness (<7). Data are reported for 1987 and 1991.
Contact Person	Karl Finison TEL: 207.623.2555; FAX: 207.622.7086 email: kfinison@mhic.org

### *Severity of Injury and Average on Scene Time for EMS Transports Related to Motor Vehicle Crashes in Maine*

Karl Finison and Gary Menchen

Scope	All persons involved in 1991 motor vehicle crashes statewide in Maine
Data Used	Crash linked to EMS, hospital and census data
Format	Management Report
Description	This management report presents the severity of injury and average on scene time by EMS capability level. Severity is defined using the revised trauma score as <3.99, 4-6.99, 7-7.84. EMS capability level is defined as paramedic, other ALS, BLS, unknown.
Contact Person	Karl Finison TEL: 207.623.2555; FAX: 207.622.7086 email: kfinison@mhic.org

6.1 EMS

## 7.0 GENERAL APPLICATIONS

### 7.1 Standardized Reporting

#### *Standardized Reporting Using CODES*

Karl Finison

Scope	All persons involved in 1996 motor vehicle crashes statewide in Maine
Data Used	Crash linked to EMS and hospital data
Format	Management Report
Description	This report describes the justification for standardized reporting as a research planning tool and to foster dissemination of CODES information. The injury pyramid and levels, classification, outcome measures, and denominators are described to indicate how the standardized reporting is achieved. Limitations of standardized reporting are discussed. Examples of Maine report formats and inpatient hospital discharge data are presented.
Contact Person	Karl Finison TEL: 207.623.2555; FAX: 207.622.7086 email: kfinison@mhic.org

#### *Demonstrating a Successful Sequence of Questions to Get the Correct Answer in Utah*

Larry Cook

Scope	All persons involved in 1992-1995 motor vehicle crashes statewide in Utah
Data Used	Crash linked to inpatient hospital discharge data
Format	Presentation
Description	This presentation lists 12 questions and their sequence for using CODES linked data. Information about crash characteristics and medical outcomes of older drivers in Utah for 1992-1995 is presented to demonstrate how the questions work.
Contact Person	Janet Almond TEL: 801.585.6410 FAX: 801.581.8686 email: janet.almond@hsc.utah.edu

7.1 Standardized Reporting



## 7.2 Annual Reports

### *Missouri Crash Outcome Data Evaluation System (CODES) 1993*

Mark Van Tuinen

Scope	All drivers involved in 1993 motor vehicle crashes statewide in Missouri
Data Used	Crash data linked to emergency room and inpatient hospital discharge data.
Format	Report
Description	This report was designed to present information not contained in the Missouri Highway Patrol's "Traffic Safety Compendium". After an introduction describing the characteristics and limitations of the data, the key findings are presented. The body of the report consists of 8 sections: Leading Causes of Death and Hospitalization, Speed Limit at the Crash Site, Safety Belt Use, Alcohol Impairment, Type of Crash, Vehicle Type, Young Drivers and Charges, Injuries and Risk Factor Summary. It has 4 appendices including a Comparison with the Traffic Safety Compendium, Summary of the Completeness and Accuracy of the Linkage Procedures, E-codes not Included in the Linked Hospital File, and Regional Planning Commission Area-County Map.
Contact Person	Mark Van Tuinen TEL: 573.751.6274; FAX: 573.526.4102 email: vantum@mail.health.state.mo.us

### *Missouri Crash Outcome Data Evaluation System (CODES) 1996*

Mark Van Tuinen

Scope	All drivers involved in 1996 motor vehicle crashes statewide in Missouri
Data Used	Crash data linked to emergency room and inpatient hospital discharge data.
Format	Report
Description	This report was designed to present information not contained in the Missouri Highway Patrol's "Traffic Safety Compendium". After an introduction describing the changes from the 1993 Report, characteristics and limitations of the linked data and the key findings are presented. The body of the report consists of 8 sections: Leading Causes of Death and Hospitalization, Speed Limit at the Crash Site, Safety Belt Use, Alcohol Impairment, Type of Crash, Vehicle Type, Young Drivers and Charges, Injuries and Risk Factor Summary. It has 4 appendices including a Comparison with the Traffic Safety Compendium, Linkage Procedures, Completeness and Accuracy, E-codes not Included in the Linked Hospital File, and Regional Planning Commission Area-County Map.
Contact Person	Mark Van Tuinen TEL: 573.751.6274; FAX: 573.526.4102 email: vantum@mail.health.state.mo.us

7.2 Reports

*Motor Vehicle Crash Outcomes in Nebraska 1996 - Management Reports*

Dan Christensen and Ming Qu

Scope	All individuals involved in reportable motor vehicle crashes in Nebraska in 1996.
Data Used	Crash residuals, crash linked to EMS, and crash linked to hospital data
Format	Management Report
Description	This report presents descriptive statistics about factors that contribute to motor vehicle traffic crashes in 1996 in Nebraska and their consequences, i.e., injury, death, and financial impact. Characteristics of persons involved in crashes, (i.e., gender, age, and type of person), injury severity, and hospital charges are defined. Several management reports describe crash outcomes. These management reports are grouped according to demographic, behavioral, and crash characteristics, crash time, crash circumstances (including environmental factors, road conditions, crash locations, and speed limits), and vehicle type. Selected subgroups (driver, teen and elderly driver, pedestrian), specific factors (alcohol related, restraint use, and speed related), and specific type of vehicle (motorcycle, and commercial motor vehicle) are defined in more detail.
Contact Person	Dan Christensen TEL: 402.471.7988; FAX: 402.471.6436 Email: dan.christensen@hhss.state.ne.us

*Motor Vehicle Crash Outcomes in Nebraska 1997 - Management Reports*

Dan Christensen and Ming Qu

Scope	All individuals involved in reportable motor vehicle crashes in 1997 in Nebraska.
Data Used	Crash residuals, crash linked to EMS, and crash linked to hospital data
Format	Management Report
Description	This report presents descriptive statistics about factors that contributed to motor vehicle traffic crashes in 1997 in Nebraska, and their consequences, i.e., injury, death, and financial impact. Characteristics of persons involved in crashes, (i.e., gender, age, and type of person), injury severity, and hospital charges are defined. All other sections contain management reports describing crash outcomes. The reports are grouped according to demographic, behavioral, and crash characteristics, crash time, crash circumstances (including environmental factors, road conditions, crash locations, and speed limits), and vehicle type. Selected subgroups (driver, teen and elderly driver, pedestrian), specific factors (alcohol related, restraint use, and speed related), and specific type of vehicle (motorcycle, and commercial motor vehicle) are defined in more detail.
Contact Person	Dan Christensen TEL: 402.471.7988; FAX: 402.471.6436 Email: dan.christensen@hhss.state.ne.us

*Utah Crash Summary 1996*

Edma Diller, Stacey Knight, Larry Cook, Pat Nechodom

Scope	All persons involved in 1996 motor vehicle crashes statewide in Utah
Data Used	Crash linked to inpatient hospital discharge data
Format	Annual Crash Report
Description	This annual report includes outcome related information about motor vehicle crashes in Utah. Graphs and tables indicate percentage of crash victims hospitalized by age and gender; length of stay and hospital charges by gender, hospital charge by belt use, average hospital charges by county of crash and belt use, charge and length of stay for hospitalizations by seating position.
Contact Person	Janet Almond TEL: 801.585.6410 FAX: 801.581.8686 email: janet.almond@hsc.utah.edu

7.2 Reports

## 8.0 APPLICATIONS FOR EVALUATING DATA QUALITY

### 8.1 Under/Over Reporting of Occurrence

#### Studies

##### *Estimate of Police Under-Reporting of Collisions in Hawaii*

Karl Kim and Lawrence Nitz

Scope	All persons involved in 1990 motor vehicle crashes in Hawaii
Data Used	Crash linked to EMS , hospital and medical insurance claims data
Format	Study
Description	This study estimates the extent of police under reporting of collisions in Hawaii. Persons involved in police reported crashes (\$1000 property damage or injury) were matched to health records for persons whose cause of injury was flagged as a motor vehicle crash. Unreported crashes were defined as those health records for the motor vehicle crash victims that did not match to a crash record. Crash reports are more likely to be missing when the injuries are minor, injury symptoms do not appear until later, the victim leaves the scene before the police arrive, the police are never called, the records are lost during processing, or inaccurate data prevented the records from linking.
Contact Person	Karl Kim TEL: 808.956.7381; FAX: 808.956.6870 email: karlk@hawaii.edu

##### *Estimate of Lie Factor for Safety Belt and Alcohol Use in Hawaii*

Karl Kim

Scope	All persons involved in 1990-1991 motor vehicle crashes in Hawaii
Data Used	Crash linked to hospital data
Format	Study
Description	This study evaluates the differences in police and hospital reporting of safety belt and alcohol use, controlled for age, gender, vehicle type, location, crash type, and injury severity. The linked data are used to estimate differences between reporting levels and the influences of various driver, vehicle, roadway, and environmental factors.
Contact Person	Karl Kim TEL: 808.956.7381; FAX: 808.956.6870 email: karlk@hawaii.edu

8.1 Under/Over Reporting

*The Lie Factor in Traffic Safety: Comparison of Police and Hospital Reporting of Seat Belt and Alcohol Use in Hawaii*

Karl Kim

Scope	369 drivers of motor vehicles involved in crashes in 1990 in Hawaii
Data Used	Crash linked to hospital data
Format	Study
Description	Documentation of seat belt and alcohol use are compared on linked police and hospital records for 369 drivers. In addition to reporting the general patterns of inconsistency between police and hospital reporting across driver, vehicle, and crash characteristics, this paper demonstrates that there are significant problems associated with the reporting of seat belt and alcohol use. Some recommendations for improving the quality and accuracy of reporting are provided.
Contact Person	Karl Kim TEL: 808.956.7381; FAX: 808.956.6870 email: karlk@hawaii.edu

*Comparative Reporting of Belt Use, Alcohol, and Type of Injury from Police, EMS, and Hospital Discharge Abstract Reports in Maine*

Karl Finison

Scope	All persons involved in 1991 motor vehicle crashes statewide in Maine
Data Used	Crash linked to EMS and inpatient hospital discharge data
Format	Study
Description	This study compares reported belt use between police and EMS records and between police and hospital records. It discusses the impact of the varying levels of specificity used by the police, EMS, and hospital records to define injury. EMS and hospital records indicating head and spinal trauma are compared to identify under-reporting of injuries. The report discusses the value of linked data to ensure valid reporting of injury outcome.
Contact Person	Karl Finison TEL: 207.623.2555; FAX: 207.622.7086 email: kfinison@nhic.org

8.1 Under/Over Reporting

*Unduplication Problem: Multiple Passengers on Buses in Maryland*

Shiu M. Ho

Scope	All persons involved in 1995-1996 motor vehicle crashes statewide in Maryland
Data Used	Crash report
Format	Study
Description	This study analyzes the duplicate records of bus passengers found in the crash reports, and determines selection criteria for the data record. Key variables used for this analysis include: age, time and day of crash, police reported injury severity, type of vehicle.
Contact person	Shiu M. Ho TEL: 410.328.4162; FAX: 410.328.3699 email: sho@ummc.umaryland.edu

*Variations in Reported Belt Use in Different State Data Files in Missouri*

Mark Van Tuinen

Scope	All persons involved in 1990 motor vehicle crashes statewide in Missouri
Data Used	Crash linked to EMS, emergency department, hospital and insurance claims data
Format	Study
Description	This study evaluates the advantages of using linked data to determine variations in reported belt use as recorded on the linked crash, EMS, and Head and Spinal Cord Injury/Trauma (HSCIT) files. Agreement rates are compared between the linked crash and EMS and the linked crash and HSCIT files. Average charges are studied to assess the affect of the disagreements in the three files.
Contact Person	Mark Van Tuinen TEL: 573.751.6274; FAX: 573.526.4102 email: vantum@mail.health.state.mo.us

8.1 Under/Over Reporting

*Over-Reporting and Measured Effectiveness of Seat Belts in Motor Vehicle Crashes in Utah*

J. Michael Dean, James C. Reading, Pat Nechodom

Scope	All persons involved in 1991 motor vehicle crashes statewide in Utah
Data Used	Crash linked to EMS and discharge summaries of medical records from hospitals and clinics (includes outpatient, emergency department, inpatient, and rehabilitation facilities)
Format	Study
Description	This study evaluates the effect of seat belt over-reporting (information biased differential misclassification) on the odds ratio and confidence limits relating seat belt use and injury. Independent observational studies from the same time period are used to obtain corrected odds ratios to provide more reasonable estimates of seat belt effectiveness.
Contact Person	Janet Almond TEL: 801.585.6410 FAX: 801.581.8686 email: janet.almond@hsc.utah.edu

*Estimates of the Effects of Seat Belt Over-Reporting on Wisconsin Motor Vehicle Crash Analyses in Wisconsin*

Trudy A. Karlson, Wayne Bigelow, Daniel Wickeham, Charles A. Quade

Scope	All persons involved in 1991 motor vehicle crashes statewide in Wisconsin
Data Used	Crash linked to hospital data
Format	Study
Description	This study presents a methodology for adjusting reported belt use to prevent an overestimate of belt effectiveness. Field observation data and logit parameters for occupant, vehicle and site characteristics are mapped into variables in the crash data to calculate a probability of belt use for every passenger vehicle occupant whose crash record contained sufficient vehicle, site and occupant information. A new dichotomous variable is created to assign occupants' belt use according to a new algorithm. Information obtained from a medical record review is also used to justify the new algorithm.
Contact Person	Martha Florey TEL: 608.266.3557; FAX: 608.267.0441 email: mflorey@mail.state.wi.us

8.1 Under/Over Reporting

## 8.2 Errors in Financial Data

### Studies

#### *Linked Hospital Discharge and Head and Spinal Cord/trauma Injury Data (HSCIT) to Compare Hospital Charges in Missouri*

Mark Van Tuinen

Scope	All persons involved in 1990 motor vehicle crashes statewide in Missouri
Data Used	Hospital linked to head and spinal cord trauma registry data
Format	Study
Description	This study identifies variations in total charges reported by two different data sources of victims injured in motor vehicle crashes. Records for patients not included in both data sources are compared according to emergency department discharge to the operating room and ICU units, length of stay, total charges, discharge to skilled nursing facility and rehab unit, fatality, superficial injuries, etc. The variations are evaluated to explain differences in the average charge generated by each data source.
Contact Person	Mark Van Tuinen TEL: 573.751.6274; FAX: 573.526.4102 email: vantum@mail.health.state.mo.us

#### *The Effects of Data Outliers and Errors in Hospital Charges on Conclusions Regarding the Efficacy of Safety Belt Use in Missouri*

Mark Van Tuinen

Scope	All persons involved in 1990 motor vehicle crashes statewide in Missouri
Data Used	Hospital linked to head and spinal cord trauma registry data
Format	Study
Description	This study evaluates the effects of data outliers and errors in hospital charges on the analysis of the effectiveness of safety belts. The potential that very high charges increase the variability of the data, making it harder to test for differences in any effect is discussed and recommendations are made.
Contact Person	Mark Van Tuinen TEL: 573.751.6274; FAX: 573.526.4102 email: vantum@mail.health.state.mo.us



### 8.3 Developing State Data

#### Studies

##### *Developing Statewide Emergency Department Data in Pennsylvania*

Harold B. Weiss

Scope	1991 Emergency Department Data
Data Used	Stratified sample of emergency department billing records from hospitals in Pennsylvania
Format	Study
Description	This study reports on the use of computerized ED patient registration, billing and log systems integrated systems using the UB-92 uniform billing format to create a statewide emergency department data base. It discusses the permanent storage of data in a computer-retrievable format, the inclusion of diagnostic and treatment information, and the likelihood for standardization of patient data for later merging at the state level.
Contact Person	Hank Weiss: TEL: 412.648.9290; FAX: 412.648.8924 email: hweiss@injurycontrol.com

## 9.0 APPLICATIONS RELATED TO THE LINKAGE PROCESS

### 9.1 Validating the Linkage

#### Studies

*Identifying Records That Should Have Linked but Did Not, and Comparing Them to Records That Did Link in Missouri*

Mark Van Tuinen

Scope	All persons involved in 1990 motor vehicle crashes statewide in Missouri
Data Used	Crash linked to EMS, emergency department, hospital and insurance claims data
Format	Study
Description	This study compares records that should have linked but did not and records that did link using the presence of linkage identifiers and the linkage methodology. The impact of the addition of the unlinked records is evaluated by comparing average charges and admission rates.
Contact Person	Mark Van Tuinen TEL: 573.751.6274; FAX: 573.526.4102 email: vantum@mail.health.state.mo.us

*Comparing Linkage Methods: Ad Hoc Linkage Versus Probabilistic Linkage in Missouri*  
 Mark Van Tuinen

Scope	All persons involved in 1990 motor vehicle crashes statewide in Missouri
Data Used	Crash linked to EMS, emergency department, hospital and insurance claims data
Format	Study
Description	This study compares the linkage of HSCI (Head and Spinal Cord Injury) and HD (Hospital Discharge) records using an Ad Hoc or Probabilistic Linkage method. The impact of the different linkage methods is evaluated using severity and the effectiveness of safety belts and helmets.
Contact Person	Mark Van Tuinen TEL: 573.751.6274; FAX: 573.526.4102 email: vantum@mail.health.state.mo.us

*Comparison of Two Hospital Data Files Using the Capture-Recapture Formula in Missouri*  
 Mark Van Tuinen

Scope	All persons involved in 1990 motor vehicle crashes statewide in Missouri
Data Used	Crash linked to EMS, emergency department, hospital and insurance claims data
Format	Study
Description	To correct for suspected under-reporting, the State Hospital Discharge File (HD) is compared to its Head and Spinal Cord Injury File (HSCI) using probabilistic linkage. Missing data rates are calculated for each file and each file is updated accordingly.
Contact Person	Mark Van Tuinen TEL: 573.751.6274; FAX: 573.526.4102 email: vantum@mail.health.state.mo.us

*Technical Report on New Mexico CODES Data Linkage for 1995*

Carrie Rudd

Scope	All persons involved in 1995 crashes statewide in New Mexico
Data Used	Crash linked to trauma registry, hospital discharge, Medicaid, and statewide coroner's data
Format	Report
Description	This report describes the New Mexico data linkage process. It also includes results of the linkage and validation of the matched pairs.
Contact Person	Stuart Castle TEL:505.827.1435; FAX: 505.827.0013 email: stuartc@doh.state.nm.us

*Probabilistic Record Linkage: Relationships Between file sizes, Identifiers, and Match Weights in Utah (in process)*

Lawrence J. Cook, Lenora M. Olson, J. Michael Dean

Scope	Artificially created databases to test linkage techniques.
Data Used	Crash linked to inpatient hospital discharge data
Format	Study
Description	This study quantifies the type and level of information needed to probabilistically link two databases. It demonstrates how much information is contained in various linkage variables, thus making it possible to choose which variables are necessary to achieve the linkage success rate desired. With this information researchers, data owners, and policy makers can develop methods that will provide a sufficient amount of identifying information to ensure the accuracy of linkages, while minimizing the need for confidential information.
Contact Person	Janet Almond TEL: 801.585.6410 FAX: 801.581.8686 email: janet.almond@hsc.utah.edu

9.1 Validation

*Nonfatal Motor Vehicle Crash Injuries: Wisconsin's Experience with Linked Data Systems*  
 Trudy A. Karlson, Chip Quade, Martha Florey

Scope	All persons injured in motor vehicle crashes 1989-1993 in Wisconsin
Data Used	Crash linked to inpatient hospital discharge data
Format	Study
Description	This 1996 study describes the five years of linked data produced by Wisconsin's CODES project. The crash and inpatient hospital discharge data bases are described in addition to the probabilistic linkage process. It presents 1993 hospitalization rates per crash occupant for passenger vehicles, trucks, motorcycles, bicycles, and pedestrians. A similar table presents the brain injury hospitalization rates for passenger vehicles, motorcycles and pedestrians. Limitations are discussed.
Contact Person	Martha Florey TEL: 608.266.3557; FAX: 608.267.0441 email: mflorey@mail.state.wi.us

REFERENCE BY STATE BY PAGE NUMBER

STATE	Yr. Funded	PAGE REFERENCES
Alaska	DEMO1	65,70
Connecticut	CODES2	20,68,73
Hawaii	CODES1	29,36,72,74,78,85,86
Iowa	CODES3	32-34, 75,76
Kentucky	CODES3	26
Maine	CODES1	7-19, 23-26,37,39-47,51-54,62,63,65,71,76,80,81,86
Maryland	CODES2	19,27,31,37,68,87
Massachusetts	CODES3	35
Missouri	CODES1	29,48,51,61,82,87,89,91,92
Nebraska	CODES3	21,31,66,83
New Hampshire	CODES2	7,72,77
New Mexico	DEMO1	27,38,93
New York	CODES1	38,69,74
Nevada	CODES2	30
North Dakota	CODES2	54-59
Oklahoma	CODES2	48,62,64,66
Pennsylvania	CODES1	32,60,75,90
South Carolina	CODES3	24
South Dakota	CODES2	22,43
Utah	CODES1	49,50,52,59,64,67,70,71,79,81,84,88,93
Wisconsin	CODES1	22,28,30,34,60,61,88,94

Date of Funding  
 CODES1 - 1992  
 DEMO1 - 1995  
 CODES2 - 1996  
 CODES3 - 1998



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

400 Seventh St., S.W.  
Washington, D.C. 20590

Official business  
Penalty for Private Use \$300