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CATALOG OF TYPES OF APPLICATIONS IMPLEMENTED USING LINKED STATE DATA

Crash Outcome Data Evaluation System (CODES)

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April 1997

National Center for Statistics and Analysis
National Highway Traffic Safety Administration
400 Seventh Street, SW, Room 6125
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1.0 INTRODUCTION

1.1 Purpose of the Catalog

The purpose of this catalog 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 as new applications are developed.

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

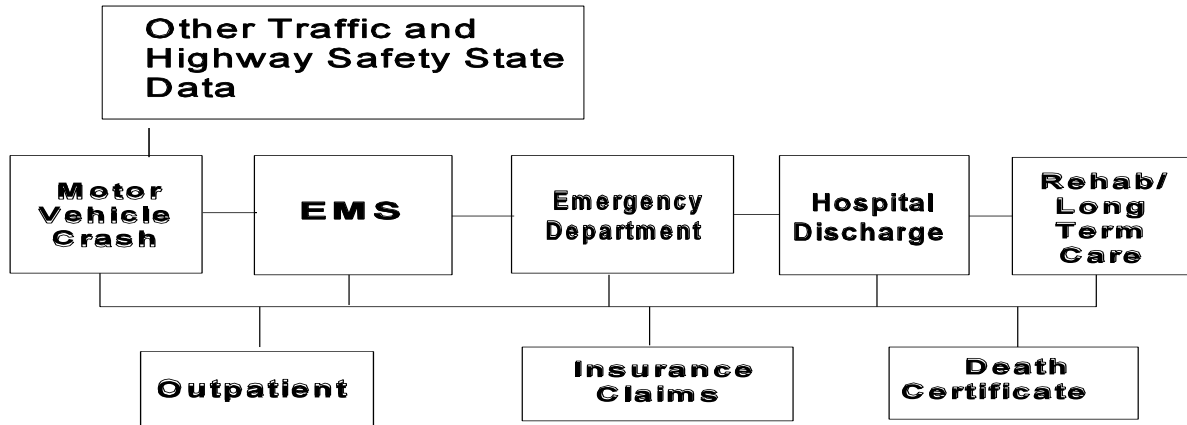


Exhibit 1

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 an Advisory Committee consisting of the owners and major users of the state data who collaboratively resolve issues related to data access, patient confidentiality, management and release of the linked data and institutionalization of CODES. 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 First Implementation of CODES

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 required analyses 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 state's linked data base varies in terms of the number of 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. Subsequently, NHTSA funded three of the CODES states (New York, Pennsylvania, Wisconsin) and three other states (Alaska, Connecticut, and New Mexico) to develop additional state-specific applications for their linked state data.

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 only a few have state 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.

The states chosen for the CODES funding were those that had the best state data. All of the CODES states had statewide crash and hospital data. Six of the seven states had statewide EMS data. More information about the experience of the CODES states performing the data linkage may be obtained from the *Technical Report: Crash Outcome Data Evaluation System Project* published by NHTSA. Exhibit 2 below presents the study populations that can be generated from the linkage of different groups of state data files.

Exhibit 2: Populations Generated by Groups of Linked Data				
Linked Statewide Data Crash Linked to:	Hospitalized	Transported by EMS	Treated in ED Regardless of EMS Transport	Treated as Outpatients at Physician's Office
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 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 of the total 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. 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 understate 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) is high enough to misrepresent the injured population. However, the failure to link may cause totals, such as total EMS transports, hospitalizations, charges, and hospital days, to be understated. In addition, average charges may be understated if the unlinked records contain injured persons 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 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 original seven CODES states (Hawaii, Maine, Missouri, New York, Pennsylvania, Wisconsin, Utah) and three additional states (Alaska, Connecticut, New Mexico). These applications reflect how the linked state data are being used to support state-specific efforts. The types of applications are listed under one of six subject areas: Injury Prevention, Traffic Safety,

Highway Safety, EMS, Data Quality, and Validating Linked Data. Each application is listed only once though it may be applicable to more than one area. Exhibit 3 presents the topic areas included within each subject area. The state-specific applications are organized alphabetically by state within each area.

Exhibit 3: Classification of State Specific APPLICATIONS for Linked Data by Subject Area and Topic	
Subject Area	Topic Areas
3.1 Injury Prevention	3.1.1 Occurrence 3.1.2 Costs
3.2 Traffic Safety	3.2.1 Crash Characteristics 3.2.2 Vehicle Characteristics 3.2.3 Person Characteristics
3.3 Highway Safety	3.3.1 Roadway
3.4 EMS	
3.5 Quality of State Data	
3.6 Validating Linked Data	

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, management report, overheads or chart)
Description	(summary of the types of information generated by the application)
Contact Person	(person to contact for more information about the application)

Copies of the studies, management reports, overheads and charts 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 and Sex

1. *The usefulness of linked data in exploring issues associated with motor vehicle crashes involving drivers ages 16 through 20 years in Alaska (in process).*

Scope	All persons involved in 1991-1995 crashes statewide in Alaska
Data Used	Crash linked to Public Safety, EMS, Trauma Registry (includes all injuries statewide that are admitted to a hospital, transferred to another acute care facility, or declared dead in the ED), and Medicaid data.
Format	Study
Description	This study uses the linked data to examine the role of youth and inexperience (drivers age 16 through 20) in motor vehicle crashes, the role of driver permits in reducing crashes among this age group, 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). 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	Mark S. Johnson, TEL: 907-465-3027; FAX: 907-586-1877

2. *Evaluation of the Elderly Driver in Motor Vehicle Crashes in Connecticut (in process)*

Scope	All persons involved in 1994 and 1995 crashes statewide in Connecticut
Data Used	Crash data linked to emergency department, ambulatory surgery, hospital discharge, trauma registry, death certificate and census data.
Format	Study
Description	This study reports the incidence of motor vehicle crashes for elderly drivers compared to younger drivers, the expected roadway locations and predictors for crashes involving the elderly, and injury outcomes for elderly victims in terms of cost, diagnosis, average length of stay, total hospital days, final disposition, and mortality at 30, 60, and 90 days.
Contact Person	Angela S. Mattie TEL: 203-294-7224; FAX: 203-284-9318

3. *Injury Rates and Outcome for Males by Age in Accidents 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 population-based injury rates and outcome for males involved in motor vehicle crashes including the total occupants, 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. Data are reported by age grouped in five year intervals.
Contact Person	Karl Finison TEL: 207-623-2555; FAX: 207-622-7086

4. *Injury Rates and Outcome for Females by Age in Accidents 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 population-based injury rates and outcome by age for females involved in motor vehicle crashes including the total occupants, 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. Data are reported by age grouped in five year intervals.
Contact Person	Karl Finison TEL: 207-623-2555; FAX: 207-622-7086

5. *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 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 were 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 were considered. Type of injury, length of stay, and hospital charges were compared for each age group.
Contact Person	Richard Guerin TEL: 518-474-2219; FAX: 518-486-6216

6. *Crashes Involving Older Drivers in New York* (in process)

Scope	All persons involved in 1994 motor vehicle crashes statewide in New York
Data Used	Crash linked to EMS and 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 will be measured using ICD-9-CM, AIS, and ISS scores.
Contact Person	Richard Guerin TEL: 518-474-2219; FAX: 518-486-6216

7. *Graduated Licensing: Using Linked Data to Evaluate Its Medical and Financial Impact in Utah*
 Pat Nechodom

Scope	All persons involved in 1991 motor vehicle crashes statewide in Utah
Data Used	Crash linked to EMS, emergency department and hospital data
Format	Presentation Overheads
Description	This presentation describes the need for and expected impact of graduated licensing on the occurrence of injury and financial charges for hospital inpatients and outpatients.
Contact Person	Pat Nechodom TEL: 801-581-6410; FAX: 801-581-8686

3.1.2 Involving Pedestrians

1. *Injury Outcome by Age Group for Male Pedestrians in Accidents 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 male pedestrians 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 age grouped into five year intervals.
Contact Person	Karl Finison TEL: 207-623-2555; FAX: 207-622-7086

2. *Injury Outcome by Age Group for Female Pedestrians in Accidents 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 female pedestrians 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 age grouped into five year intervals.
Contact Person	Karl Finison TEL: 207-623-2555; FAX: 207-622-7086

3. *Injury Outcome by County of Accident Location for Pedestrians Involved in Accidents 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 county of crash location 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. Data are reported for the 16 counties in Maine.
Contact Person	Karl Finison TEL: 207-623-2555; FAX: 207-622-7086

4. *Injury Outcome by Month of Accident for Pedestrians in Accidents 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

5. *Injury Outcome by Day of Week of Accident for Pedestrians in Accidents 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

6. *Injury Outcome by Time of Accident (1 hour intervals) for Pedestrians in Accidents 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

7. *Injury Outcome for Pedestrians Involved in Alcohol-Related Accidents 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

8. *Injury Outcome for Pedestrians Involved in Motor Vehicle Crashes by Population Density of Accident 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

9. *Injury Outcome for Pedestrians Involved in Crashes by Roadway Location of Accident 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 the 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

10. *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

3.1.3 Involving Bicyclists

1. *Injury Outcome by Age Group for Male Bicyclists Involved in Accidents 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 age in five year intervals for male bicyclists 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.
Contact Person	Karl Finison TEL: 207-623-2555; FAX: 207-622-7086

2. *Injury Outcome by Age Group for Female Bicyclists Involved in Accidents 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 female bicyclists involved in crashes the injury outcome by age in five year intervals 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.
Contact Person	Karl Finison TEL: 207-623-2555; FAX: 207-622-7086

3. *Injury Outcome by County of Accident Location for Bicyclists Involved in Accidents 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 county 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. Data are reported for 16 counties in Maine.
Contact Person	Karl Finison TEL: 207-623-2555; FAX: 207-622-7086

4. *Injury Outcome by Month of Accident for Bicyclists Involved in Accidents 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

5. *Injury Outcome by Day of Week of Accident for Bicyclists Involved in Accidents 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

6. *Injury Outcome by Time of Accident (1 hour intervals) for Bicyclists Involved in Accidents 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

7. *Injury Outcome for Bicyclists Involved in Alcohol-Related Accidents 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

8. *Injury Outcome for Bicyclists Involved in Motor Vehicle Crashes by Population Density of Accident 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

9. *Injury Outcome for Bicyclists Involved in Crashes by Roadway Location of Accident 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 the 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

10. *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

3.1.4 By Geographic Location

1. *Analysis of the Medical and Financial Outcomes of Crash Injuries Occurring in Connecticut*(in process)

Scope	All persons involved in 1994-1995 crashes in Connecticut
Data Used	Crash data linked to hospital discharge, ambulatory surgery, emergency department, trauma registry, death certificate and census data.
Format	Study
Description	This study reports on the predictors for motor vehicle crashes and the location of injuries in Connecticut, and describes the injured victims of these crashes in terms of their severity scores and outcomes by final disposition, financial cost, discharge diagnosis, average length of stay, total hospital days, and mortality at 30, 60, and 90 days.
Contact Person	Angela S. Mattie TEL: 203-294-7224; FAX: 203-284-9318

2. *Injury Outcome by County 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 county in Maine, the 1990 census population, the total occupants, number 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 the 16 counties in Maine.
Contact Person	Karl Finison TEL: 207-623-2555; FAX: 207-622-7086

3. *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

4. *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

3.1.5 By Date and Time

1. *Injury Outcome by Month of Accident 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

2. *Injury Outcome by Day of Week of Accident 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 in Maine, 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

3. *Injury Outcome by Time of Accident 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

3.1.6 By Type of Injury

1. *Incidence and Cost of Traumatic Brain Injury in New Mexico* (in process)

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	Study
Description	This study reports on the incidence and cost motor vehicle and non-motor vehicle related causes of Traumatic Brain Injury. Linked data will be 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, ethnicity, geographic distribution, external cause, extent of hospitalization, length of coma, involved alcohol, work related, payer source(s), and costs.
Contact Person	Stuart Castle TEL 505-827-1435; FAX: 505-827-0013

2. *Variations in Incidence and Cost for Lower Extremity Injuries in Wisconsin* (in process)

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 will be evaluated as potential factors for affecting severity and type of injury. Who pays will be 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

3.2 Occurrence of Health Care Costs

3.2.1 Costs and Safety Belt Use

1. *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 report presents Missouri specific results of the effectiveness of safety belts on injuries and costs.
Contact Person	Mark Van Tuinen TEL: 573-751-6274; FAX: 573-526-4102

3.2.2 Who Pays?

1. *Who Incurs and Pays for Hospital Care for Motor Vehicle Accident Victims in Pennsylvania?(in process)*

Scope	All persons involved in 1994 motor vehicle crashes statewide in Pennsylvania
Data Used	Crash linked to EMS and hospital discharge data
Format	Study
Description	This study focuses on the financial implications of driver behavior related to safety belt or air bag use on Medicaid, Medicare expenditures, and insurance premiums for vehicle and health insurance, and Worker's compensation. 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 payor source is obtained from the hospital discharge data.
Contact Person	Hank Weiss TEL: 412-647-1117; FAX: 412-647-1111

3.2.3 Medicaid and Costs

1. *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	The 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 were 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 were not included. Alcohol and safety belt use were considered in relation to the costs.
Contact Person	Martha Florey TEL: 608-266-3557; FAX: 608-267-0441

3.2.4 Comparing Hospital Costs

1. *Computing Hospital Costs Savings Using the Entire Crash Population Rather than Only Hospitalized Cases in Utah*

J. Michael Dean

Scope	All persons involved in 1991 motor vehicle crashes statewide in Utah
Data Used	Crash linked to EMS, emergency department and hospital data
Format	Study
Description	This study describes models to compute hospital costs using the entire crash population. Non-hospitalized occupants were assigned a charge of \$0 when the potential cost savings for belt use by the entire crash population was calculated.
Contact Person	Pat Nechodom TEL: 801-581-6410; FAX: 801-581-8686

4.0 APPLICATIONS FOR TRAFFIC SAFETY

4.1 Crash Characteristics

1. *Injury Outcome by Posted Speed Limit 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 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

2. *Injury Outcome by Accident Type 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 crash type 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. 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, rollover, fire, submersion, rock thrown, jack knife, missing/invalid, other.
Contact Person	Karl Finison TEL: 207-623-2555; FAX: 207-622-7086

3. *Injury Outcome by Roadway Location of Accident 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 roadway location of 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. 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

4. *Injury Outcome by Light Conditions of Accident 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 light condition of 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. Light conditions are defined as dawn (morning), daylight, dusk (evening), dark (street lights on), dark (no street lights), dark (street lights off), other, missing/invalid.
Contact Person	Karl Finison TEL: 207-623-2555; FAX: 207-622-7086

5. *Injury Outcome by Road Surface of Accident 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 road surface of 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. Road surface is defined as dry, wet, snow/slush sanded, snow slush not sanded, ice packed snow sanded, ice packed snow not sanded, muddy, debris, oily, other, missing/invalid.
Contact Person	Karl Finison TEL: 207-623-2555; FAX: 207-622-7086

6. *Injury Outcome by Type of Road Work at Accident 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 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 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

7. *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

8. *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

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

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	Models were constructed 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 were considered. Average and total charges were calculated for both models to determine the impact of the different methodologies.
Contact Person	Richard Guerin TEL: 518-474-2219; FAX: 518-486-6216

4.2 Vehicle Characteristics

1. *Injury Outcome by Vehicle Type 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 vehicle type, the total occupants, number 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, years of potential life lost, and the relative risk. Vehicle type defined as an occupant of car/light truck, motorcycle rider, pedestrian, bicyclist, bus, commercial truck and other/unknown.
Contact Person	Karl Finison TEL: 207-623-2555; FAX: 207-622-7086

2. *Injury Outcome by Type of Emergency Vehicle Involved in Accident 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 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 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

3. *Assessing Crash Severity through Vehicle Damage, Point of Damage on Vehicle, Number of Vehicles in Crash, Posted Speed and Impact Speed in Utah*
J. Michael Dean

Scope	All persons involved in 1991 motor vehicle crashes in Utah
Data Used	Crash linked to EMS, emergency department and hospital data
Format	Study
Description	This study compared several measures as surrogates for crash severity, including “totaled” or “not totaled.”
Contact Person	Pat Nechodom TEL: 801-581-6410; FAX: 801-581-8686

4.3 Person Characteristics

4.3.1 Safety Belts

1. *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: 202-366-7078

2. *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	Includes technical information about the probabilistic linkage and state specific 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: 202-366-7078

3. *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 measured 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 included occupants of cars and light trucks.
Contact Person	Karl Finison TEL: 207-623-2555; FAX: 207-622-7086

4. *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 used conditional logistic regression to determine whether alternative analytic techniques led to similar conclusions as those prepared using NHTSA's mandated CODES model. This type of analysis provided more control for the circumstances and severity of the crash than is possible based on measured variables, and generates estimates that may be more poolable across states than estimates based on standard unconditional logistic regression.
Contact Person	Douglas Thompson TEL: 207-780-4682 FAX 207-780-4953

5. *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 was 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

6. *Injury Outcome by Seating Position in Cars and Light Trucks Only Involved in Accidents 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 seating position in cars and light trucks only 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. Seating position is defined as driver, front seat passenger, rear seat passenger, trunk/back of truck, hanging on, missing/unknown/invalid.
Contact Person	Karl Finison TEL: 207-623-2555; FAX: 207-622-7086

7. *Injury Outcome by Number of People in Cars and Light Trucks Involved in Accidents 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

8. *Total Occupants, and Number and Percent Injured By Type of Ejection in Accident 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 total occupants and the number and percent injured by type of ejection in crashes in Maine. Ejection levels are defined as not ejected, partially ejected, ejected, trapped-extricated, other/missing.
Contact Person	Karl Finison TEL: 207-623-2555; FAX: 207-622-7086

9. *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

4.3.2 Air Bags

1. *Air Bag Effectiveness in Pennsylvania* (in process)

Scope	All persons involved in 1994 crashes statewide in Pennsylvania
Data Used	Crash linked to EMS and hospital discharge data statewide
Format	Study
Description	This study reports on the effectiveness of air bags in reducing total and average hospital costs, mortality, and morbidity from motor vehicle crashes. Air bag effectiveness is evaluated alone and in combination with safety belts for various types of demographic, crash, and injury characteristics.
Contact Person	Hank Weiss TEL: 412-647-1117; FAX: 412-647-1111

4.3.3 Helmet Utilization

1. *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 were 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

2. *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

4.3.4 Alcohol and Drug Use

1. *Injury Outcome in Alcohol-Related Accidents 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

2. *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

3. *Injury Outcome by Apparent Physical Condition of Driver in Single Vehicle Accidents 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 of the driver in a single vehicle crash the injury outcome 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

5.0 APPLICATIONS FOR HIGHWAY SAFETY

5.1 Roadway

5.1.1 Objects in Roadway

1. *Evaluation of Severity and Outcome of Injury by Type of Object Struck in Connecticut (in process)*

Scope	All persons involved in 1994-1995 crashes statewide in Connecticut
Data Used	Crash data linked to hospital discharge, ambulatory surgery, emergency department, trauma registry, death certificate and census data
Format	Study
Description	This study identifies discharge diagnoses, injury severity scores, location of the crashes by type of object struck; outcomes for injured victims are reported in terms of their final disposition, financial cost, discharge diagnosis, average length of stay, total hospital days, and mortality at 30, 60, and 90 days.
Contact Person	Angela S. Mattie TEL: 203-294-7224;FAX: 203-284-9318

2. *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 was defined as moose, deer, and other.
Contact Person	Karl Finison TEL: 207-623-2555; FAX: 207-622-7086

3. *Collisions With Utility Poles, Guide rails, and Median Barriers in New York* (in process)

Scope	All persons involved in 1994 motor vehicle crashes statewide in New York
Data Used	CODES linked data; Utility industry for costs of moving utility poles; New York State DOT for costs of modifying or replacing Guide rails and median barriers
Format	Study
Description	This study provides information about the consequences of collisions with fixed objects including, medical outcome and health care costs by type of object struck, demographic and roadway characteristics of this type of crash, cost and payors for replacing or moving the fixed object.
Contact Person	Richard Guerin TEL: 518-474-2219; FAX: 518-486-6216

4. *Effectiveness of Guide Rails in Reducing Severity, Injury and Death in Single Vehicle Fixed Object Collisions in Pennsylvania.* (in process)

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 effectiveness of guide rails in reducing severity and incidence of injury and mortality associated with single vehicle fixed object crashes. The effectiveness of breakaway design in roadside hardware will also be evaluated.
Contact Person	Hank Weiss TEL: 412-647-1117 FAX: 412-647-1111

6.0 APPLICATIONS FOR EMS

6.1 Occurrence of EMS Transports

1. *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

2. *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 applications to analysis of location characteristics of EMS runs. Analyses of point, segment, and areal aspects of EMS calls for young drivers, motorcyclists, victims of utility pole and bus/pedestrian crashes and cardiac emergencies that have application to EMS and transportation policy planning are presented.
Contact Person	Karl Kim TEL: 808-956-7381; FAX: 808-956-6870

6.2 Injury Severity and EMS

1. *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

2. *CODES Victim Severity as Predicted by EMS Variables in Utah*
J. Michael Dean

Scope	All persons involved in 1991 motor vehicle crashes statewide in Utah
Data Used	Crash linked to EMS, emergency department, hospital and insurance claims data
Format	Study
Description	This study describes the relationship of safety belt use and need for specific EMS treatments.
Contact Person	Pat Nechodom TEL: 801-581-6410; FAX: 801-581-8686

7.0 APPLICATIONS RELATED TO THE QUALITY OF STATE DATA

7.1 Under-Reporting of Collisions

1. *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

7.2 Over-reporting of Belt Use

1. *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 hospital discharge data
Format	Study
Description	This study compared 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 were compared to identify under-reporting of injuries. The results reported reinforced the view that valid reporting of the injury outcome of motor vehicle crashes can best be accomplished through the linkage of crash to hospital discharge and other medical records.
Contact Person	Karl Finison TEL: 207-623-2555; FAX: 207-622-7086

2. *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 evaluated 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 were compared between the linked crash and EMS and the linked crash and HSCIT files. Average charges were 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

3. *Over-Reporting and Measured Effectiveness of Seat Belts in Motor Vehicle Crashes in Utah*
 J. Michael Dean

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 were used to obtain corrected odds ratios to provide more reasonable estimates of seat belt effectiveness.
Contact Person	Pat Nechodom TEL: 801-581-6410; FAX: 801-581-8686

4. *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 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 was created to assign occupants' belt use according to a new algorithm. Information obtained from a medical record review was also used to justify the new algorithm.
Contact Person	Martha Florey TEL: 608-266-3557; FAX: 608-267-0441

7.3 Errors in Financial Information

1. *Linked hospital discharge and Head and Spinal Cord/Trauma Injury Data (HSCIT) to Compare Hospital Charges in Missouri*
Mark Van Tuinan

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 identified 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 were 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 were 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

2. *The Effects of Data Outliers and Errors in Hospital Charges on Conclusions Regarding the Efficacy of Safety Belt Use in Missouri*
Mark Van Tuinan

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 evaluated 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

7.4 Developing State Data

1. *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: 412-647-1117; FAX: 412-647-1111

8.0 APPLICATIONS RELATED TO THE LINKED STATE DATA

8.1 Validating the Linkage

1. *Identifying Records That Should Have Linked but Did Not, and Comparing Them to Records That Did Link in Missouri*
Mark Van Tuinan

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 compared 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 was evaluated by comparing average charges and admission rates.
Contact Person	Mark Van Tuinen TEL: 573-751-6274; FAX: 573-526-4102

2. *Comparing Linkage Methods: Ad Hoc Linkage Versus Probabilistic Linkage in Missouri*
Mark Van Tuinan

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 was evaluated using severity and the effectiveness of safety belts and helmets.
Contact Person	Mark Van Tuinen TEL: 573-751-6274; FAX: 573-526-4102

3. *Comparison of Two Hospital Data Files Using the Capture-recapture Formula in Missouri*
 Mark Van Tuinan

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) was compared to its Head and Spinal Cord Injury File (HSCI) using probabilistic linkage. Missing data rates were calculated for each file and each file was updated accordingly.
Contact Person	Mark Van Tuinen TEL: 573-751-6274; FAX: 573-526-4102

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