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Crash Outcome Data Evaluation System (CODES): Program Transition and Promising Practices

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16. Abstract

The Crash Outcome Data Evaluation System (CODES) is a State-based program originally developed in 1992 by the National Highway Traffic Safety Administration under NHTSA's National Center for Statistics and Analysis. CODES uses a statistical linkage process known as probabilistic linkage to combine information from motor vehicle crash reports and hospital records, sometimes also adding databases from sources such as emergency medical services (EMS), death certificate, and others. CODES originally operated through cooperative agreements between NHTSA and grantees in member States. In 2013, NHTSA transitioned the CODES programs to full State-level responsibility. This report summarizes the history of CODES, relates the transition plan, and describes CODES-related projects and output from 2009 to 2014, including a compilation of abstracted State-specific linked data applications.

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Executive Summary

The Crash Outcome Data Evaluation System (CODES) is a State-based program initiated in 1992 by the National Highway Traffic Safety Administration (NHTSA) under NHTSA's National Center for Statistics and Analysis. CODES links State crash report data to State medical outcome data using an advanced probabilistic linkage methodology.

Probabilistic linkage is a powerful method for combining information from different databases into a single dataset for analysis. Desired information about study subjects is often contained in two or more databases, and if a unique key to allow perfect matching does not exist between these databases, it is not possible to combine the information directly. Rather than relying on a unique key to combine records, probabilistic linkage makes use of fields that are common to each database.

The CODES Data Network, a supplemental program for States that had successfully completed a CODES startup, involved cooperative agreements between NHTSA and participating States. The agreements allowed NHTSA to provide technical assistance and limited funding that would not have otherwise been made available to States. In 2013, NHTSA discontinued the CODES Data Network and transitioned the CODES program to full State-level responsibility. NHTSA encouraged transitioning States to continue the program independently and to seek and secure other funding sources, including NHTSA funds via State grants when appropriate.

CODES data reside in the States where the linkage originated, and NHTSA does not own or disseminate CODES data files. Queries may be directed to State projects (Table 5).

To preserve knowledge about the program and help inform current and future linkage projects, this paper summarizes the history of CODES, as well as the transition plan. This report also describes the CODES Data Network output from 2009 to 2014.

Special studies completed by the CODES Data Network from 2009 to 2014 included:

- a motorcycle helmet study using data from 18 States;
- an alcohol reporting data request using data from 7 States;
- a two-State collaboration on comparing injury measurement methods; and,
- a final technical report on methodology and pooled data applications.

Collaborations with other Federal agencies from 2009 to 2014 were:

- a collaboration with the Centers for Disease Control and Prevention involving data analyses and a program analysis of linkage projects with a survey and focus groups; and,
- data support to the National Transportation Safety Board for a study on single-unit trucks.

State-specific data applications shared by grantees in 2009 to 2012 covered:

- objectives of problem identification, traffic safety decision-makers support, traffic safety legislation support, and public education; and,
- subject matter areas such as child safety, impaired driving, motorcycle safety, seat belts, young drivers, crash factors, injuries, older occupants, pedestrians, data dissemination, and coalition building.

1. Introduction

The Crash Outcome Data Evaluation System (CODES) is a State-based program originally developed in 1992 by the National Highway Traffic Safety Administration (NHTSA) under NHTSA's National Center for Statistics and Analysis. CODES uses a statistical linkage process known as probabilistic linkage to combine information from motor vehicle crash reports and hospital records, sometimes also adding databases from sources such as emergency medical services (EMS), death certificate, and others.

Linking crash data to medical data allows crashes to be analyzed by injury diagnoses, regions, and severity at a more advanced and accurate level than police reports, which usually limit injury information to police observation. Linked medical data also allow crash research to include variables such as level of care, discharge status, charges, length of stay, payer, and societal cost projections (NHTSA, 2010).

Probabilistic linkage is a powerful method for combining information from different databases into a single dataset for analysis. Desired information about study subjects is often contained in two or more databases, and if a unique key to allow perfect matching does not exist between these databases, it is not possible to combine the information directly. Rather than relying on a unique key to combine records, probabilistic linkage makes use of fields that are common to each database. Using the information in the entire dataset, the probability that a candidate match is a true match can be quantified with statistical methods (Cook, Thomas, Olson, Funai, & Simmons, 2015).

Data linkage is rarely perfect, and in the case of crash to medical data linkage, available identifiers or matching variables differ from State to State. Using only matches that are based on perfectly recorded identifiers may result in bias and under-coverage in estimates and analyses, as some identifiers may be missing, misrecorded, or subject to variation in spelling, nicknames and such; and some States simply do not have individual identifiers available. To attain population-based estimates, CODES uses an advanced probabilistic linkage methodology involving multiple imputations of missing links (McGlincy, 2004). Since it is impossible to perfectly know when linkage is correct, CODES practitioners use data simulations to test linkage models (McGlincy, 2006). CODES also uses advanced analytical techniques involving multiply imputed data (Cook et al., 2015). This report does not expand on the technical discussions of the statistical methods behind data linkage and related analyses; for additional information in those areas, please refer to the cited references.

2. CODES Background and Transition

2.1. CODES Origin and Operation

NHTSA initially created CODES to quantify and report on the benefits of safety equipment and legislation in terms of mortality, morbidity, injury severity and health care costs. The effort was undertaken in response to Section 1031(b) of the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA), which required NHTSA to conduct a study and report to the Congress on the benefits of seat belt use and motorcycle helmet use in crashes. In 1992, NHTSA initiated a grant program with existing State-based sites that were capable of generating crash, medical, and

financial outcome information by accessing and linking statewide datasets. Any State agency, non-profit organization, or educational institution was eligible to develop and coordinate a coalition of data owners and users to perform the desired linkages. Applicants were required to demonstrate the existence and accessibility of appropriate source data systems, to work with NHTSA to implement the probabilistic linkage algorithm, and to ensure availability of the resulting linked data to NHTSA for use in preparing the mandated report to Congress.

Seven States were awarded grants effective October 1, 1992, to establish CODES (Johnson & Walker, 1996). NHTSA created the mandated safety report using linked crash, EMS, hospital discharge, and emergency department data from the seven States (NHTSA, 1996). Some results were that the average inpatient charge for unbelted passenger vehicle drivers admitted to an inpatient facility as a result of a crash injury was more than 55-percent greater than the average charge for those that were belted, and that motorcycle helmets were 67-percent effective in reducing brain injuries. In 1996, these data findings were the first of their kind, presenting outputs that expanded understanding in areas where previously little had been known about injuries and other medical outcomes.

CODES became institutionalized in the awarded States based on a series of partnerships between State traffic safety agencies, public health agencies, and NHTSA. Since then, States that were able to successfully link at least two years of crash and injury outcome data had the opportunity to apply and join the CODES Data Network. NHTSA's National Center for Statistics and Analysis provided partial funding support through cooperative agreements and also coordinated the network, providing technical and program assistance. Grantees were from a diverse group of disciplines and included State agencies, universities or affiliates, and non-profit institutions. In some instances, grantees entered into agreements with support entities, such as universities, to conduct the actual data linkage and/or analyses.

To become a CODES site, a State was required to have statewide crash report data, hospital inpatient data, and either emergency medical service or emergency department data available for linkage. As programs advanced, some States added ancillary data sets such as death certificate, trauma registry, driver citation, and motor vehicle licensing data.

Grantees were also required to assemble and convene a CODES board of directors comprised of the data owners; report to NHTSA on progress of linkage and analysis efforts; and, participate in NHTSA data requests and annual training meetings. NHTSA provided software, training, coordination, and annual technical assistance meetings. Linked data remained at the State for analytical use, and NHTSA did not take possession of the CODES data.

The CODES Data Network also featured grantee interaction. Members came to know each other and might assist each other with methodology questions, analytical ideas, and such. In 2008, to develop support systems further, two grantees took on support roles, with NHTSA coordination, as resource centers. The technical resource center at Utah CODES assisted grantees with linkage and analytical topics, and also coordinated and analyzed multi-State studies; and the program resource center at Maryland CODES provided support in programmatic areas such as meeting facilitation and instructor/facilitator training, as well as auxiliary analytical collaboration.

As CODES continued to develop, funding from NHTSA became more limited. Grantees were encouraged to seek and secure other supplemental funding for their CODES program and to

move towards program institutionalization and increased independent funding to ensure future sustainability.

2.2. CODES Transition to State Management

In 2009, NHTSA produced an internal CODES strategic plan aimed at strengthening CODES at all levels. The plan also advised current CODES members that CODES must eventually become fully responsible for operations and management at the State level. Five overall objectives were identified to help guide and strengthen the CODES efforts and support an eventual transition:

- Develop, implement and manage an integrated multi-stakeholder system at the State and national level leveraging necessary resources (time, money, personnel, and equipment) as needed.
- Continue to advance the interpretation/analysis of multiple data sets to influence traffic safety using state-of-the-art methodologies leveraging the use of appropriate software, equipment, and training.
- Establish a foundation for data sharing with key stakeholders – NHTSA, State Highway Safety Offices, TRCC, and other potential data users.
- Create greater demand for CODES data by continuing to educate others on the power, benefit and application of the CODES efforts in a "real world" context.
- Assess the medical and economic impact of injuries to influence and inform best practice outreach interventions, engineering design (equipment and roadway), and policy changes.

From 2009-2012, NHTSA's National Center for Statistic and Analysis worked with CODES grantees and the NHTSA Regional Offices to address these objectives and thereby foster better understanding and dissemination of CODES capabilities and analyses. Informational webinars were conducted with topics such as orientation for new CODES analysts, "brown bag" analytical topics for CODES practitioners, informational presentations for NHTSA Regional Offices, and "grand rounds" sessions open to the public. Annual technical assistance meetings added programmatic topics such as instructor/facilitator training and increased emphasis on analytical topics and State presentations.

In 2012, NHTSA communicated a final transition plan of autonomy to grantees. Under the plan, CODES cooperative agreements would not be renewed after 2013, and sites would become responsible for full management of their CODES program. Sites were encouraged to continue to seek other funding sources, including possible funding from NHTSA State grants, to continue data linkage and analysis. In that year, CODES cooperative agreements were in effect in 15 States: Connecticut, Delaware, Georgia, Illinois, Kentucky, Maine, Maryland, Minnesota, Missouri, Nebraska, New York, Ohio, South Carolina, Utah, and Virginia.

Under the plan, all remaining NHTSA CODES cooperative agreements expired by the end of 2013. After transition, each State followed its own chosen path; some continued the project, some reduced or retired the concept, and others were in flux, seeking opportunities to continue. NHTSA still supports the concept of data linkage and continues to encourage linkage and related analyses as highly useful data methods for traffic safety.

During transition, NHTSA did not become owners of State CODES data, and does not house the data. CODES data reside in the States where the linkage originated, and NHTSA does not

disseminate CODES data. Requests for data or information are handled by the State CODES project sites. Web addresses of the 2009-2013 CODES grantees are provided in Table 5.

3. Recent Work of the CODES Data Network

In support of the internal strategic plan, NHTSA and the CODES Data Network undertook a number of initiatives and collaborations from 2009-2014. Full reports are available as cited for each of the projects summarized here.

3.1. Expanded Analyses

Motorcycle Helmet Analysis
Data from 18 States in the CODES Data Network, covering 104,472 motorcyclists in crashes from the years 2003-2005, were standardized and analyzed through the CODES Technical Resource Center as reported in the NHTSA publication *Motorcycle Helmet Use and Head and Facial Injuries: Crash Outcomes in CODES Linked Data* (Cook, Kerns, Burch, Thomas, & Bell, 2009). The report found that helmets significantly reduced the odds of sustaining head or facial injury, traumatic brain injury, and dying in the hospital. It also found that the use of standardized data generated in multiple CODES States proved to be feasible and productive, and held promise for future enhancements of methods using pooled CODES data.

Alcohol and Police Reporting
CODES data on alcohol and injury from seven States, covering 550,933 linked driver records from 2006 to 2008, were standardized and tabulated to support a data request from NHTSA's Office of Regulatory Analysis and Evaluation preparing an updated report on the Economic Costs of Crashes. The Association for the Advancement of Automotive Medicine Findings published an added analysis of the submitted tables in the paper *Underreporting of Driver Alcohol Involvement in United States Police and Hospital Records: Capture-Recapture Estimates* (Miller et al., 2012). Findings included that alcohol underreporting varied widely between States, that police alcohol reporting completeness rose with police-reported driver injury severity, and that police and hospitals need to communicate better about alcohol involvement.

Injury Severity Scales
The Utah and Maryland CODES projects collaborated on a comparison of police-reported injury severity to medically diagnosed injury severity. It found that diagnosis-based severity measures were less variable than police-reported severity in the examined data. The resulting article, *A Comparison of KABCO and AIS Injury Severity Metrics Using CODES Linked Data* (Burch, Cook, & Dischinger, 2013), published in the journal *Traffic Injury Prevention*, presents results and also offers a descriptive discussion of types of injury scales.

Overview of Methodologies and Multi-State Traffic Safety Applications
As part of the final CODES cooperative agreements and collaboration with CDC, the CODES Technical Resource Center at the University of Utah produced a two-part final report on CODES methodologies and example data uses. The report, *CODES: Examination of Methodologies and Multi-State Traffic Safety Applications* (Cook et al., 2015), was provided for publication as a means to preserve knowledge and to present valuable technical information related to data linkage as well as the potential of linked data analysis. The report provides a technical explanation of CODES linkage and an overview of other available methods; a comparison of

analyses using data produced from probabilistic multiple-imputed, maximum a posteriori, and high-probability links; an examination of match probabilities generated by various linking variables; a study and comparison of missing data imputation and resulting estimates; an initiative to standardize CODES data into common fields across States, expanding on the type of standardization undertaken for the motorcycle report; and demonstration uses of standardized 2005-2008 data for four subject area implementations.

3.2. Interagency Collaborations

Centers for Disease Control and Prevention
CDC has identified motor-vehicle-related injuries as one of seven "Winnable Battles," and CDC's National Center for Injury Prevention and Control (NCIPC) has a team to address transportation safety (CDC, n.d.[b]). In 2010, the administrators of the CDC and NHTSA signed a Memorandum of Understanding for collaborative efforts (CDC, 2011). CODES was identified as potentially having the kind of data and characteristics appropriate for addressing CDC priorities. In 2010, CDC and NHTSA entered an inter-agency agreement to explore the feasibility and benefits of an ongoing partnership that included the CODES program. Under the agreement, CDC staff received training in the CODES software and analysis techniques, working hands-on with CODES projects in Georgia and South Carolina. CDC determined that linked data, such as that produced by CODES, supported two of the agency's strategic directions:

- Excellence in surveillance, epidemiology, and laboratory services.
- Strengthen support for State, tribal, local, and territorial public health.

In addition, the linked data produced by CODES could be used to support all four phases of the public health model (Mercy, Rosenberg, Powell, Broome, & Roper, 1993) set forth by the NCIPC:

1. Identify, define and measure the problem.
2. Identify risk, protective and other key factors that can help define the "community" profile.
3. Develop and test prevention strategies in an evidence-based approach to program planning.
4. Assure widespread adoption through dissemination techniques such as training, networking, technical assistance, and evaluation (CDC, n.d. [a]).

As NHTSA finalized plans for the transition of State CODES programs to autonomy, the CDC requested to undertake a program appraisal that would gather and preserve programmatic information related to CODES and other State data linkage programs. Under the continued interagency agreement, CDC, NHTSA, and the University of Maryland's National Study Center for Trauma and EMS collaborated on the project using a variety of quantitative and qualitative efforts to collect program information, including a survey, focus groups, and secondary data. A final report*, Assessment of Characteristics of State Data Linkage Systems*, presents the results and defines specific barriers and facilitators interrelated with linkage programs (Milani et al., 2015).

National Transportation Safety Board
In 2011, the NTSB, an independent Federal agency, approached NHTSA about the possibility of using CODES data in a study on single-unit truck crashes and injuries. CODES data were preferred to unlinked crash data because of the diagnosis-based injury information. NHTSA worked with five CODES Data Network States that were willing to participate in the study and that had access to the needed variables, including Vehicle Identification Numbers. NHTSA and

the CODES resource centers assisted participating States in data assembly and NTSB in understanding the linkage and analysis techniques used with the CODES program. NTSB staff conducted the analyses and presented a formal report on June 4, 2013 (NTSB, 2013a). The NTSB approved the report and issued recommendations concerning single-unit truck safety as well as data recommendations. One issued finding of the study was that

> Data from the Crash Outcome Data Evaluation System provide detailed information on injury diagnoses and severity in relation to crash characteristics, cover a large proportion of the population of the participating States, are not available elsewhere, and provide useful insight into traffic safety problems. (NTSB, 2013b)

4. Promising Practice Data Applications

CODES Data Network grantees traditionally shared selected data applications in annual technical assistance meetings. Emphasis was placed on applications that promoted promising practices, notable impact, influence and/or recognition. This section presents abstracts of State applications presented from 2009 to 2012 by grantees in Connecticut, Delaware, Georgia, Illinois, Kentucky, Maine, Maryland, Minnesota, Missouri, Nebraska, New York, Ohio, South Carolina, Utah, and Virginia. Each abstract summarizes the population and traffic safety issue targeted, research methodologies conducted, findings, and applicable uses from the findings. A reader's guide precedes the tables, summarizing applications by objective appropriate for implementing safety designs. The tables are further categorized by traffic safety subject area for added reader convenience. The section then presents abstracts in order of year and State.

The chosen objective areas parallel the above described public health model (Section 3.2) of problem definition, risk factor identification, intervention design, and implementation. Specifically, the tables organize the objectives by (1) identifying traffic safety problems that pose a threat to the community; (2) supporting traffic safety-decision makers examining the problem, (3) supporting traffic safety legislation designed to address the problem, and (4) educating the public about the problem and/or the intervention.

Objective 1 - Identify Traffic Safety Problems

CODES data are population-based, so the large volume of data generated as the result of annual linkage in most CODES States can help identify safety issues. Such data outputs can help traffic safety professionals, health practitioners and others use findings to identify and define traffic safety concerns instrumental in program development and implementation. Table 1 provides a reference to problem identification-related data applications by subject matter (crash factors, child safety, impaired driving, motorcycle safety, and young drivers).

Objective 2 - Support Traffic Safety Decision Makers

Linked data can provide statewide information to support safety efforts and data requests by elected officials and coordinating agencies such as the Traffic Records Coordinating Committees, funding/planning agencies such as the State Highway Safety Offices and departments of public health/injury control, or data users such as the members of the CODES advisory committee. Such analyses can help decision-makers identify risk factors and plan for interventions. Table 2 summarizes examples of traffic-safety decision-making support

applications by subject type (coalition building, child safety, crash factors, impaired driving, injuries, motorcycle safety, older adults, pedestrians and pedal cyclists, seat belts, and young drivers).

Objective 3 - Support Traffic Safety Legislation

Problem identification through risk factor analysis can be used to address public or administrative policy concerns, as another mitigation strategy used in injury prevention. Medical and financial information generated by linked data can demonstrate expected savings in terms of decreased health care costs and injury severity. CODES projects have often provided such data to support either pending or existing legislation. Table 3 summarizes applications in support of safety legislation change by subject type (child safety, impaired driving, motorcycle safety, seat belts, and young drivers).

Objective 4 - Educate the Public

CODES programs rely on partnerships. Their associated boards are typically comprised of the data owners. Through these partnerships, CODES programs prepare outputs to meet their partner's needs as well as that of the public for education and outreach. Fact sheets and other resource-specific materials can present compelling stories through numbers for public dissemination. Table 4 provides a reference to public education support applications by subject matter (crash factors, child safety, data dissemination, motorcycle safety, and young drivers).

While many applications may easily fall into multiple areas, they are categorized here by high focus area. Applications presented herein are limited to those reported at annual meetings and do not represent a complete registry of all analyses conducted by the States during this period.

The presented abstracts are provided for informational purposes on diverse uses of linked data at the State level. The CODES data used are owned by and reside within the State CODES projects. Any opinions, findings, and conclusions expressed in the abstracts or their related analyses are those of the authors and not necessarily those of the Department of Transportation or the National Highway Traffic Safety Administration. For questions or further information pertinent to a specific application, the organization housing the State CODES project is specified in each abstract. Table 5 provides Web site information for each featured CODES site.

Table 1: 2009-2012 State CODES Applications Supporting Problem Identification

Year, State and Application by Type of Subject Matter		Page
Crash Factors		
2009 Nebraska	***Adverse Weather-Related Crashes in Nebraska*** This study used 2004-2006 imputed Nebraska CODES data to describe crashes that occurred under adverse weather conditions. Contribution factors were identified to help design prevention strategies and policies to reduce occurrence, injury severity, and economic loss of such crashes.	29
2012 Ohio	***Factors Affecting Motor Vehicle Crashes in Ohio, 2004-2009*** The purpose of this study was to describe the medical and economic impact of factors associated with distracted driving, aggressive driving, and impaired driving that affect MVC-related injuries to Ohioans.	78
Child Safety		
2010 Connecticut	***Promoting Back Seat Travel for Children Under 13 in Connecticut*** The CT CODES Project examined the impact of seating positions (front seat versus back seat) and restraint use on injury severity for children	36
2010 Georgia	***Promoting Optimal Restraint Use Among Children Under 10 in Georgia*** The GA CODES Project analyzed the impact of restraint systems for children under 10.	38
2011 New York	***Using CODES to Promote Back Seat Usage for All Children up to 12 Years Old in New York State*** In 2011 the New York CODES project supplied data to the NY Child Injury Prevention Policy Subgroup to support their initiatives to reduce childhood motor vehicle injuries.	62
2011 Utah	***Driver Seat Belt Use Indicates Decreased Risk for Child Passengers in Motor Vehicle Crashes in Utah*** We show an association between driver characteristics, including seat belt use, and child motor vehicle crash-related medical outcomes, suggesting interventions targeted at drivers have potential to improve medical outcomes of child passengers.	65
Impaired Driving		
2011 Delaware	***Injury Analysis of Delaware Alcohol-Impaired-Driving Crashes*** Using CODES data to analyze the hospital charges/costs in alcohol-impaired driving crashes to prevent injuries, save lives, and reduce economic costs of motor vehicle crashes on Delaware's roadways.	54
Motorcycle Safety		
2009 Delaware	***Injury Comparisons in Motorcycle Crashes*** In Delaware from 2003 to 2005, there were 44 motorcyclists killed and 464 injured; motorcyclists involved in crashes who were not wearing helmets were 2 times more likely to have TBI.	18
2009 Maine	***Maine Motorcycle Crashes: Causes and Injury Outcomes*** A study of the causes and injury outcomes for motorcycle crashes in Maine distinguished single-vehicle motorcycle crashes from crashes involving another vehicle and evaluated injury outcomes using linked hospital data.	24
2012 Minnesota	***Is It Boomers and Their Harleys? Motorcycle Crash in Minnesota*** After describing the increasing trend in motorcycle rider fatalities and injuries in recent years, we used CODES linked data to identify associated modifiable and non-modifiable risk factors.	74
Young Drivers		
2012 Delaware	***Injury Analysis of Delaware Teen Driving Crashes*** Using CODES data to analyze the hospital charges/costs in teen driving crashes to prevent injuries, save lives, and reduce economic costs of motor vehicle crashes on Delaware's roadways.	69
2012 New York	***Using CODES Data to Support an Innovative Approach to Teen Driver Safety in N.Y.*** CODES data is being used by the New York Partnership for Teen Driving Safety to explore the issues surrounding younger drivers.	77

Table 2: 2009-2012 State CODES Applications Supporting Traffic Safety Decision-Makers

Year, State and Application by Type of Subject Matter		Page
Coalition Building		
2009 South Carolina	***Building a CODES Coalition in South Carolina*** Coalition building with a variety of traffic safety stakeholders in an effort to reduce injuries and fatalities on South Carolina roadways.	32
Crash Factors		
2009 Nebraska	***Adverse Weather-Related Crashes in Nebraska*** This study used 2004-2006 imputed Nebraska CODES data to describe crashes that occurred under adverse weather conditions. Contribution factors were identified to help design prevention strategies and policies to reduce occurrence, injury severity, and economic loss of such crashes.	29
2011 Connecticut	***Characteristics of Connecticut Crashes in Rural Versus Non-Rural Settings*** The Connecticut CODES Project examined the differences between crashes that occurred in rural versus non-rural settings.	53
2011 Minnesota	***Using Minnesota CODES to Describe the Health Outcomes of Lane Departure Crashes*** In a joint effort with the Minnesota DOT, we analyzed factors and health outcomes of lane departure crashes, incorporating CODES linked data, presenting the results at Minnesota's annual TZD conference.	59
2012 Maryland	***Experience Counts – Maryland Crash and Citation Rates for Newly Licensed Drivers Regardless of Age*** A comparison of subsequent crash and citations rates between newly licensed drivers and those who renewed or transferred their license during 2009 to identify any differences based on inexperience, not merely younger age in Maryland.	73
2012 Ohio	***Factors Affecting Motor Vehicle Crashes in Ohio, 2004-2009*** The purpose of this study was to describe the medical and economic impact of factors associated with distracted driving, aggressive driving, and impaired driving that affect MVC-related injuries to Ohioans.	78
2012 Utah	***Using Utah CODES Data to Identify Work-Related Motor Vehicle Crashes*** We demonstrate the utility of linked motor vehicle crash and hospital databases to provide a more complete picture of work-related MVCs. The linked database is used to estimate the burden of work-related MVCs in Utah.	80
Child Safety		
2010 Connecticut	***Promoting Back Seat Travel for Children 13 in Connecticut*** The CT CODES Project examined the impact of seating positions (front seat versus back seat) and restraint use on injury severity for children	36
Impaired Driving		
2011 Illinois	***Using Path Models to Determine the Effects of Safety Belt and Alcohol Impairment on Injury Severity and Hospitalization Costs Among Illinois Crash Victims*** Using the 2005 linked crash and hospital discharge data, this report intends to provide data and information on head injuries and belt status of occupants of passenger cars in Illinois.	55
Injuries		
2009 Illinois	***Determinants of Hospital Charges Among Occupants of Motor Vehicle Crash Victims in Illinois*** Using the 2003 linked crash and hospital discharge data, the report provides data and information on cost and medical outcomes of occupants of motor vehicles who were injured in motor vehicle crashes and hospitalized in Illinois hospitals.	20
2009 Ohio	***The Medical and Economic Impact of Motorized Recreation Vehicle-Related Traumatic Brain Injury in Ohio*** This study described the medical and economic impact of motorized-recreational-vehicle-related (MRV-related) traumatic brain injuries in Ohio for 2003 to 2006, and provided recommendations for MRV safety.	31

Table 1: 2009-2012 State CODES Applications Supporting Problem Identification

2010 Indiana	***Model-Based Application of the Abbreviated Injury Scale to Police-Reported Crash Injuries*** Ordered logit models are used to estimate the AIS level of injury based on the entries in the police crash reports and to estimate the cost of the injury which does not exhibit the selectivity bias present in the linked data.	40
2010 Kentucky	***Nonfatal Crash Injury Indicators for Kentucky's Strategic Highway Safety Plan*** This collection of eight brief reports enables tracking of morbidity resulting from motor vehicle crashes in eight of the emphasis areas from Kentucky's Strategic Highway Safety Plan.	41
2010 Mass.	***Using CODES Data to Examine Hospital Costs and Frequency Comparisons Associated With Different Types of Collisions*** Massachusetts looked at the hospital costs associated with different types of crashes, including single-vehicle and various multi-vehicle crashes, to help inform Massachusetts transportation officials about the most injurious crashes, and to support policies to improve traffic safety.	43
2011 Kentucky	***Using CODES Data to Estimate the Burden of Cervical Sprain and Strain Injuries Resulting From Motor Vehicle Crashes in Kentucky*** This report documents the incidence of acute cervical sprain and strain injuries resulting from motor vehicle crashes in Kentucky, and provides estimates of the long-term impact of those injuries in terms of disability and direct medical costs.	56
2011 Nebraska	***Magic Behind Nebraska's Motor Vehicle Crash Fatality Trend*** We examined Nebraska CODES and other related data sources to identify factors that contributed to motor vehicle crash fatality decline in Nebraska in the last decade.	61
2012 Georgia	***Using Georgia CODES Data to Develop a System Dynamics Model on Motor Vehicle Safety*** Georgia CODES project collaborated with Georgia Health Policy Center to develop a System Dynamics Model on Injury Prevention focusing on Motor Vehicle. 2005 and 2008 CODES linked data was used.	70
Motorcycle Safety		
2009 Indiana	***Indiana Motorcycle Crash Patterns and Injury Outcomes*** Indiana was interested in the types of motorcycle collisions where the use of helmets would be most important. There was also interest in understanding the basic differences in outcomes between occupants in passenger vehicles and occupants on a motorcycle.	21
2009 Maine	***Maine Motorcycle Crashes: Causes and Injury Outcomes*** A study of the causes and injury outcomes for motorcycle crashes in Maine distinguished single-vehicle motorcycle crashes from crashes involving another vehicle and evaluated injury outcomes using linked hospital data.	24
2009 Virginia	***Virginia CODES Supports DMV's Virginia Highway Safety Office Motorcycle Rider Education Program*** For the 2008 Motorcycle Safety Session of the Virginia Annual Conference on Transportation Safety (ACTS), Virginia CODES analyzed motorcycle crash data by fatalities, injuries and hospital outcomes to support the Motorcycle Rider Education Program Presentation.	34
2010 Ohio	***Motorcycle-Crash-Related Injuries in Ohio, 2005 to 2007*** The goal of this study was to describe key factors associated with outcome of individuals who sustain motorcycle-crash-related injuries in Ohio.	48
2011 Virginia	***Using CODES Data to Analyze Motorcycle Crash Outcomes in Virginia*** Analysis of 2001-2007 motorcycle crash data combining motor vehicle conviction data and student training data.	66
2012 Illinois	***Motorcycle-related Crash Victims and Their Associates Hospital Charges in Illinois*** Using the 2009 linked crash and hospital discharge and ED data, this report intends to provide data and information on head injuries and helmet status of motorcyclists in Illinois.	71
2012 Kentucky	***Differences in Protective Effect of Motorcycle Helmets by Nature of Traumatic Brain Injury in Kentucky*** This study uses CODES data to show that motorcycle helmets offer substantial protection against skull fracture and intracranial injury, and moderate protection against concussion.	72

Table 1: 2009-2012 State CODES Applications Supporting Problem Identification

2012 Minnesota	***Is It Boomers and Their Harleys? Motorcycle Crash in Minnesota*** After describing the increasing trend in motorcycle rider fatalities and injuries in recent years, we used CODES linked data to identify associated modifiable and non-modifiable risk factors.	74
Older Adults		
2009 Mass.	***Hospital Charges and Payer Sources for Older Driver Crashes*** Linked Massachusetts crash and hospital data were analyzed to better understand hospital charges and payer sources for vehicle occupants in older driver crashes.	26
2010 Maryland	***Trends of Vehicular Crash Injuries and Hospitalizations: Influence of Age*** The purpose of this analysis is to examine statewide crash mortality and injury trends over time, by age groups, to examine changes in injury rates and patterns, taking into account the fact that newer, safer vehicles are coming into the overall fleet.	42
2011 Ohio	***Injuries Among Older Adults in Ohio, 2004 – 2009*** The goal of this study was to describe key factors associated with injuries among adults age 70 years or older in Ohio, with particular emphasis on motor vehicle crashes, pedestrian collisions, falls, residential fires, and self-inflicted injuries.	63
Pedestrians and Pedal Cyclists		
2012 Connecticut	***Characteristics and Outcomes of Connecticut Pedestrian and Pedal Cyclist Crashes*** The Connecticut CODES Project examined the characteristics of crashes that involved pedestrians and cyclists.	68
Seat Belts		
2010 Illinois	***The Effect of Safety Belt Use on Head Injuries Among Crash Victims*** Using the 2005 linked crash and hospital discharge data, this report intends to provide data and information on head injuries belted and unbelted occupants of passenger cars in Illinois.	39
2011 Maryland	***Maryland Nighttime Seat Belt Enforcement Campaign*** A collaborative effort between the NSC, MHSO, and NHTSA was organized to determine if a Click It or Ticket (CIOT) enforcement model could be modified to effectively reduce the numbers of unbelted incapacitating injuries and/or fatalities during nighttime hours.	58
2011 New York	***Using CODES to Promote Back Seat Usage for All Children up to 12 Years Old in New York State*** In 2011 the New York CODES project supplied data to the NY Child Injury Prevention Policy Subgroup to support their initiatives to reduce childhood motor vehicle injuries.	62
Young Drivers		
2009 Iowa	***Motor Vehicle Crashes Among Teens and Their Hospitalizations in Iowa, 2002-2006*** Teen drivers and passengers and their relation to the risks of not using seat belts, sustaining head injury, alcohol use, the higher number of occupants in the back seat.	22
2012 New York	***Using CODES Data to Support an Innovative Approach to Teen Driver Safety in N.Y.*** CODES data is being used by the New York Partnership for Teen Driving Safety to explore the issues surrounding younger drivers.	77
2012 Virginia	***Reducing Young Driver Crashes, Injuries and Fatalities on Virginia Roadways*** VAHSO analyzed young drivers 15 to19 and their fatalities and injuries. In a joint effort, Virginia CODES worked with the Virginia Highway Safety Office to compile all available crash, conviction and CODES hospitalization data and highway-related information for the report.	81

Table 3: 2009-2012 State CODES Applications Supporting Traffic Safety Legislation

Year, State and Application by Type of Subject Matter		Page
Child Safety		
2009 Kentucky	***Injuries to Booster-Age Children in Kentucky, 2000-2004*** In Kentucky from 2000 to 2004, children 4 to 8 who were restrained in a child safety seat were 40 percent less likely to be hospitalized than those who were not; they also had lower hospital charges, length of stay in hospital, and overall injury severity score.	23
2009 New York	***Effects of Upgraded Child Restraint Law in New York State*** The NY CODES project analyzed crash data to show the UCRL implemented in March 2005 in New York State has been effective in reducing traffic injuries to 4- to 6-year-olds, which safety benefit is largely explained by the increasing usage of the child restraint systems for those child passengers.	30
2010 Virginia	***Using CODES Data to Support Child Restraint Legislation*** During the 2010 Virginia General Assembly legislative session, Virginia CODES supplied data to DMV's Office of Highway Safety to successfully support the restraint law bill SB219 to raise the age for wearing restraint in the back seats to 18.	51
Impaired Driving		
2009 Maryland	***Paint a Picture of Maryland's Impaired Driving Dilemma*** In July 2007, MD CODES was asked to present to the MD DUI Task Force to frame the problem of individuals driving under the influence of drugs and alcohol. During the 2009 MD State legislative session, the MD CODES project was again asked to help explain the issue using compelling data analyses and interpretation.	25
2010 Nebraska	***Who's Using? Who's Losing? How Nebraska CODES Supported the "Use and Lose" Law*** Nebraska CODES provided injury and hospital charges information related with underage drinking and driving to endorse the "use-and-lose" law during the 2010 legislative session.	46
Motorcycle Safety		
2009 Missouri	***Estimated Increase in Number of Head-Injured Motorcyclists and Program Costs if the Motorcycle Helmet Law Is Weakened*** CODES data were used to estimate the increase in TBIs and the number of TBI patients added to the Department of Health and Senior Services Adult Head Injury Program if a bill to weaken the helmet law was passed. This was to provide estimates of cost for the bill's fiscal note.	28
2010 Minnesota	***Using CODES Data to Support Additional Mandatory Insurance For Non-helmeted Riders*** We examined the potential impact of non-helmet use on hospital charges, generating results in the right direction but with a charge differential that many observers found underwhelming.	44
Seat Belts		
2009 Georgia	***Using CODES Data to Support Eliminating the Pickup Truck Seat Belt Exemption*** The Georgia CODES Project analyzed and provided data on pickup truck occupants and their hospital outcomes by those occupants wearing or not wearing a seat belt. This data was provided to support to eliminate the seat belt exemption during the 2009 legislation session.	19

Table 3: 2009-2012 State CODES Applications Supporting Traffic Safety Legislation

Year, State and Application by Type of Subject Matter		Page
2009 Minnesota	***Using CODES Data to Support Passing of the Primary Seat Belt Law in Minnesota*** Minnesota CODES data were used by government officials and safety advocates to support primary seat belt legislation, which the Minnesota governor signed at the zenith of the 2009 legislative session.	27
2009 Utah	***Using CODES Data to Support Primary Safety Belt Legislation*** During the 2009 Utah State legislative session, the Utah CODES project supplied data to traffic safety advocates and Utah agencies to support legislation for a primary seat belt law.	33
2010 South Carolina	***The Effect of Mandatory Seat Belt Use Law on the Medical and Financial Outcomes of Persons Involved in Crashes in South Carolina*** A comparison of the medical and financial outcomes of persons involved in crashes in South Carolina prior to and after the passage of South Carolina Code of Laws § 56-5-6520, the mandatory use of seat belts.	49
2011 Missouri	***Using CODES Data to Determine the Effectiveness of Seat Belts in Lowering Healthcare Costs and Reducing the Risk of Death in Missouri.*** The goal of this study was to analyze Missouri's crash and injury data to determine the effectiveness of seat belts in preventing deaths and lowering healthcare costs.	60
2012 Missouri	***Costs Saved and Fatalities and Injuries Prevented by Use of Seat Belts in Missouri*** Hospital, E/D, mortality and crash records for 2007-2008 were linked and analyzed to estimate cost savings and the number of injuries and fatalities prevented by safety-belt use by drivers of passenger vehicles.	74
2012 Nebraska	***To wear or not to wear seat belt: A comparison of crash outcomes of restrained and non-restrained occupants in Nebraska*** We used 5 years of Nebraska CODES data to compare crash outcomes of restrained and non-restrained occupants, and to provide evidence support for primary enforcement of seat belt law.	75
Young Drivers		
2009 Connecticut	***Crash Involvement of 16- to 17-Year-Old Drivers in Connecticut*** Support for improvements to Connecticut's Graduated Driver's License Law and for long-term recommendations from Governor's Task Force on Safe Teen Driving.	17
2010 Utah	***Using CODES Data to Support Utah Senate Bill 113, Wireless Telephone Use Restriction for Minors in Vehicles*** During the 2010 legislative session, Utah CODES provided linked crash and hospital statistics to traffic safety advocates and legislators for crashes involving teen distracted driving.	50

Table 4: 2009-2012 State CODES Applications Supporting Public Education

Year, State and Application by Type of Subject Matter		Page
Crash Factors		
2009 Nebraska	***Adverse Weather-Related Crashes in Nebraska*** This study used 2004-2006 imputed Nebraska CODES data to describe crashes that occurred under adverse weather conditions. Contribution factors were identified to help design prevention strategies and policies to reduce occurrence, injury severity, and economic loss of such crashes.	29
2009 Ohio	***The Medical and Economic Impact of Motorized Recreation Vehicle-Related Traumatic Brain Injury in Ohio*** This study described the medical and economic impact of motorized recreational vehicle (MRV)-related traumatic brain injuries in Ohio for 2003 to 2006, and provided recommendations for MRV safety.	31
2012 Ohio	***Factors Affecting Motor Vehicle Crashes in Ohio, 2004-2009*** The purpose of this study was to describe the medical and economic impact of factors associated with distracted driving, aggressive driving, and impaired driving that affect MVC-related injuries to Ohioans.	78
Child Safety		
2010 Connecticut	***Promoting Back Seat Travel for Children Under 13 in Connecticut*** The CT CODES Project examined the impact of seating positions (front seat versus back seat) and restraint use on injury severity for children	36
2010 Georgia	***Promoting Optimal Restraint Use Among Children Under 10 in Georgia*** The GA CODES Project analyzed the impact of restraint systems for children under 10.	38
2011 New York	***Using CODES to Promote Back Seat Usage for All Children up to 12 Years Old in New York State*** In 2011 the New York CODES project supplied data to the NY Child Injury Prevention Policy Subgroup to support their initiatives to reduce childhood motor vehicle injuries.	62
Data Dissemination		
2010 Missouri	***Update of Missouri CODES Web Application*** The Missouri CODES Web application allows users to develop tables of CODES data	45
2011 South Carolina	***Using CODES Data to Supplement the South Carolina Traffic Collision Fact Book*** Starting with the 2010 CODES data, the South Carolina Department of Public Safety will supplement the annual South Carolina Traffic Collision Fact Book crash statistics with health outcome statistics derived from the CODES data.	64
Motorcycle Safety		
2009 Virginia	***Virginia CODES Supports DMV's Virginia Highway Safety Office Motorcycle Rider Education Program*** For the 2008 Motorcycle Safety Session of the Virginia Annual Conference on Transportation Safety (ACTS), Virginia CODES analyzed motorcycle crash data by fatalities, injuries and hospital outcomes to support the Motorcycle Rider Education Program Presentation.	34
2012 Minnesota	***Is It Boomers and Their Harleys? Motorcycle Crash in Minnesota*** After describing the increasing trend in motorcycle rider fatalities and injuries in recent years, we used CODES linked data to identify associated modifiable and non-modifiable risk factors.	74
Young Drivers		
2012 New York	***Using CODES Data to Support an Innovative Approach to Teen Driver Safety in N.Y.*** CODES data is being used by the New York Partnership for Teen Driving Safety to explore the issues surrounding younger drivers.	77
2012 South Carolina	***Evaluating the Characteristics and Outcomes of Crashes Involving Teen Drivers in South Carolina*** The South Carolina CODES data were analyzed for the differences in crash characteristics and hospital outcomes stratified by age (teen drivers versus older drivers).	79

2009 Promising Practice Applications Using CODES Data

CRASH OUTCOME DATA EVALUATION SYSTEM
Promising Practice Applications Using CODES Data

Crash Involvement of 16- to 17-Year-Old Drivers in Connecticut

Connecticut CODES, 2009
Connecticut Department of Public Health (DPH)

Abstract

Connecticut would like to see improvements be made to its graduated driver's licensing (GDL) laws. Through the use of Connecticut CODES an analysis was conducted that helped define the issues facing younger drivers. The analysis showed the 16- to 17-year-old drivers were more likely to be at fault than any other driver age group. Speeding was a contributing factor most often in crashes involving 16- to 17-year-old drivers. Results from this work were shared with the Connecticut CODES Advisory Board and key points incorporated into legislative testimony.

1. Project Purpose

Support for improvements to Connecticut's Graduated Driver's License Law and for long-term recommendations from Governor's Task Force on Safe Teen Driving.

2. Methodology

Data Used

Data from 2001 to 2005 linking Connecticut crash, inpatient hospitalization, and emergency department data was used for the analysis. The analysis was conducted to expand work that was begun during a 2008 Connecticut Legislative Session using 2002-2004 data.

Procedure

The analysis compared crashes involving 16- to 17-year-old drivers, with four other age groups of drivers; 18-19-year-olds, 20-34-year-olds, 35-49-year-olds, and 50+ years. Factors analyzed included in Injury severity (MAIS), restraint use, Speed as a contributing factor, driver-at-fault, presence/age of passengers, driver impairment, nighttime driving, and medical costs.

3. Results

The analysis showed the 16- to 17-year-old drivers were more likely to be at fault than any other driver age group. Speeding was a contributing factor most often in crashes involving 16- to 17-year-old drivers. With the exception of drivers 50+ years, 16- to 17-year-old drivers and persons in crashes involving 16- to 17-year-old drivers are more likely to have serious to critical injuries. The 16- to 17-year-old drivers involved in crashes are more likely to be carrying teen passengers than any other age driver and teen passengers are more likely to receive serious injuries in crashes with 16- to 17-year-old drivers.

4. Discussion

Results from this work were shared with the Connecticut CODES Advisory Board. Key points that highlighted the increased risks for 16- to 17-year-old drivers were incorporated into legislative testimony presented at a Transportation Committee Public Hearing in support of the 2008 GDL changes. A one-page summary was shared with DPH Leadership and subcommittee members of the Governor's Task Force. Connecticut Teen Safe Driving Council was formed to bring together stakeholders to share information; implement long-term recommendations from the State Task Force and to monitor effectiveness of GDL laws. DPH staff participate in the Council and share CT CODES data when feasible. Members of the CODES Advisory Board recommended using the Injury Severity Score (ISS) rather than the MAIS since the ISS takes into consideration serious injuries to multiple parts of the body. CT CODES will be calculating ISS scores for this analysis.

CRASH OUTCOME DATA EVALUATION SYSTEM
Promising Practice Applications Using CODES Data

Injury Comparisons in Motorcycle Crashes

Delaware CODES, 2009
Office of Emergency Medical Services, DPH, DHSS

Abstract

Delaware CODES conducted analysis to demonstrate the impact of helmet use on preventing deaths and traumatic brain injuries among motorcyclists. Results were meant to help educate the public in an effort to reduce motorcycle fatalities and injuries in Delaware.

1. Project Purpose

The Delaware Office of Highway Safety tried to reach both motorcyclists and drivers of passenger vehicles through its *Ride Safe, Ride Smart* campaign, in an effort to reduce motorcycle fatalities and injuries. CODES provided the motorcycle data to Highway Safety Office and CODES stakeholders to support the motorcycle safety program.

2. Methodology

Data Used

Delaware linked imputed crash and hospital data for the years 2003-2005 were used in this application.

Procedure

Descriptive statistics were used to compare the crash and injury outcomes for motorcyclists involved in crashes.

3. Results

Approximately 62 percent of motorcyclists involved in crashes wore helmets while riding. Motorcyclists involved in crashes who were not wearing helmets were 44 percent more likely to die, 28 percent more likely to be hospitalized, and 2 times more likely to have a TBI. More than 23 percent of injured motorcyclists were admitted to a hospital. The average hospital charge for motorcyclists not wearing helmets ($33,338) was higher than for those wearing helmets ($32,433).

4. Discussion

The result of the study was presented using the power point format at CODES board meeting. Motorcycle safety fact sheet was distributed to CODES stakeholder and highway safety officers. Delaware CODES plans to continue to monitor and analyze motorcycle crashes data.

CRASH OUTCOME DATA EVALUATION SYSTEM
Promising Practice Applications Using CODES Data

Using CODES Data to Support Eliminating the Pickup Truck Seat Belt Exemption

Georgia CODES, 2009
Georgia Dept. of Human Resources, Division of Public Health, Injury Prevention Section

Abstract

The Georgia CODES Project analyzed and provided data on pickup truck occupants and their hospital outcomes by those occupants wearing or not wearing a seat belt. These data were provided to support eliminating the seat belt exemption during the 2009 legislation session. A more in-depth analysis was conducted to estimate the amount of hospital charges that would have been saved if the pickup truck occupants were restrained.

1. Project Purpose

Currently Georgia is the only State with a primary belt law that excludes pickup trucks. The director of the Governor's Office of Highway Safety and members of the CODES board requested a pickup truck fact sheet. CODES provided the pickup truck data to GOHS and CODES stakeholders.

2. Methodology

Data Used

Linked Georgia crash, inpatient and emergency department data for years 2004 and 2005 were used. This updated analysis expanded on the previous analysis of 2001-2002 linked data used during the 2005-2006 legislative session.

Procedure

Occupants of pickup trucks were grouped by restrained and non-restrained and admitted to the hospital or treated and released from the ED. Charges were compared within groups stratified by restraint use. Estimates saved used calculations from passenger vehicles (passenger car, van, and SUV) stratified as described above.

3. Results

The analysis showed that compared to restrained pickup truck occupants, unrestrained pickup truck occupants were 4 times as likely to be admitted to the Hospital ($65,000 average charge) instead of treated and released from the Emergency Department ($2,800 average charge) in 2005. An estimate based on 2007 Georgia Crash Data and 2005 linked data showed that if pickup truck occupants were restrained, a third (approximately $30 million) of the hospital and emergency room charges would have been saved.

4. Discussion

Results were shared with the CODES Board. Key points were included on the Pickup Truck Crashes in Georgia: 2007 fact sheet and disseminated among the CODES Board. The bill to remove the exemption of pickup truck occupants from the primary belt law passed the Senate but did not pass the House Committee on Agriculture and Consumer Affairs by a 4-3 vote. We are planning to update the information and investigate other analyses next year.

CRASH OUTCOME DATA EVALUATION SYSTEM
Promising Practice Applications Using CODES Data

Determinants of Hospital Charges Among Occupants of Motor Vehicle Crash Victims in Illinois

Illinois CODES, 2009
Illinois Department of Transportation, Division of Traffic Safety

Abstract

The Illinois CODES project used 2003 linked crash and hospital discharge data; specifically information on cost and medical outcomes of occupants of motor vehicles who were injured and hospitalized in Illinois. Analysis outcomes were then to be used by highway safety professionals enabling them to identify and implement appropriate countermeasures aimed at reducing motor vehicle-related injuries.

1. Project Purpose

The Illinois CODES project was initiated by Illinois Department of Transportation (IDOT) in cooperation with the Illinois Department of Public Health (IDPH) to provide appropriate data analysis needed for highway safety project planning. Results of the linked data were presented to the Illinois CODES Advisory Group, Illinois Traffic Records Coordinating Committee (ITRCC), and Highway Safety Planning (HSP) committee at Department of Traffic Safety (DTS). Trend analyses was conducted to provide cost and medical outcomes of crash victims in Illinois for problem IDs and evaluations on highway safety projects and programs.

2. Methodology

Data Used

Illinois linked 2003 person level crash records to 2003 augmented hospital inpatient discharge records.

Procedure

CODES2000's probabilistic record linkage procedures were used to create five separate multiply imputed data sets of linked records. The imputed linkage results served as the input data set to SAS' PROC MI to create multiple imputations replacing missing values with estimated values. SAS' PROC MIANALYZE was used to evaluate means and standard errors.

3. Results

Based on the linked data, a total of 5,098 records were identified to be admitted and discharged from Illinois hospitals. The overall mean charge for a traffic injury was $31,646 and the average length-of-stay was 6.8 days. Over 67.3 percent of the hospital charges were covered under private commercial insurance, 16.5 percent covered by Medicaid and Medicare, and 16.2 percent covered by the patients. Results of logistical regression models indicate that belted occupants tend to have lower hospital charges, controlling for impairment, degree of injuries, and demographics.

4. Discussion

Results have been shared in Illinois with program areas related to seat belts, impairment, and speed. Specific crash demographic information was shared with the personnel from the entire highway safety office. Additional results will continue be shared and outputs reproduced as other more current data sets become available.

CRASH OUTCOME DATA EVALUATION SYSTEM
Promising Practice Applications Using CODES Data

Indiana Motorcycle Crash Patterns and Injury Outcomes

Indiana CODES, 2009
Center for Road Safety, Purdue University

Abstract

Indiana was interested in the types of motorcycle collisions where the use of helmets would be most important. There was also interest in understanding the basic differences in outcomes between occupants in passenger vehicles and occupants on a motorcycle.

1. Project Purpose

Provide a comparison between passenger vehicle and motorcycle crashes causes and injury outcomes. Study the helmet protective effect in different types of motorcycle collisions. The project was requested by Indiana Criminal Justice Institute, Traffic Safety Division, as a consequence of the perceived motorcycle problem in Indiana. Motorcycles represent 0.8 percent of vehicles in crashes but account for 8 percent of the fatal crashes. Indiana also has a very low helmet usage rate.

2. Methodology

Data Used

This analysis used 2003-2006 linked Indiana crash, EMS and hospital inpatient and outpatient data.

Procedure

Occupants of motorcycles and passenger vehicles were separated and their crash outcome was evaluated for different types of collision and collisions with different types of objects or barriers. The effect of wearing a helmet was evaluated for the different conditions. The measure was in terms of hospital charges, MAIS, and length of stay. All linked data was used, and missing data was imputed.

3. Results

Overall, when aggregating both inpatients and outpatients, motorcycle occupants not wearing helmets incurred in charges 46 percent higher than those helmeted. The effect of speed and type of road was also shown. Helmets were found to be most effective in rollovers and falls, or when the crash occurred off road. They were found to be less effective in crashes against passenger vehicles, utility poles, culverts and guardrail ends. The first two probably cause other highly traumatic injuries and the last two may inflict severe slashing injuries. When colliding against another motor vehicle, motorcycle occupant charges were found to be on average 1.8 times higher than those of passenger vehicles in similar crashes. The highest differences were in collisions against trees, where motorcycle occupants had charges up to 3.8 times higher than occupants of passenger vehicles.

4. Discussion

Results were presented at the TRCC meetings at the Criminal Justice Institute. Tables and charts, along with interpretations were distributed. INDOT was also made aware of the results, which resulted in further interest mentioned below. The results were incorporated into the current Indiana planning to reduce motorcycle fatalities and evaluation of the feasibility of implementing helmet usage legislation. INDOT was interested in a more specific study, covering areas where cable barriers were installed. They are very successful in limiting the severity of passenger vehicle crashes, but there are suggestions that they make motorcycle crashes more severe.

CRASH OUTCOME DATA EVALUATION SYSTEM
Promising Practice Applications Using CODES Data

Motor Vehicle (MV) Crashes Among Teens and Their Hospitalizations in Iowa, 2002-2006

Iowa CODES, 2009
Center for Health Statistics, Iowa Department of Public Health

Abstract

As MV crashes are the leading cause of injury hospitalization for teens, Iowa analyzed motor vehicle-related inpatient discharges by vehicle type and age groups (16-18 and 19-20), compared to adult group (28-30). Since 66 percent of the hospitalized teens were injured in passenger cars, specific focus was given in that area.

1. Project Purpose

In 2009, Iowa did not have a seat belt law which allowed police to ticket non-restrained occupants in the back-seat older than age 11. Results from the CODES analysis were to be used educationally throughout the State to influence legislative change both for back seat seat belt use and GDL restrictions on numbers of teen passengers allowed in a vehicle under 18 during the GDL period.

2. Methodology

Data Used

Iowa Crash/Inpatient linked CODES data 2002-2006

Procedure

Descriptive analysis by comparing earlier teens to late teens and young adult group in risk factors.

3. Results

Motor vehicle crashes are the leading cause of injury hospitalization for Iowa teens, accounting for 21 percent of all injury hospitalizations in its age group. Compared to the adult group (21-64-year-old), teen's (16-20) MV-related hospitalization rate was 1.7 times higher (123.0 hospitalizations per 100,000 people versus 74.8 of adult group).

Comparison between hospitalized teens (16-18) and young adults (28-30) in passenger cars

66 percent of hospitalized teens were injured in passenger car crashes versus 45 percent of young adults

32 percent of teens were passengers instead of drivers versus 16 percent of young adults; 11 percent of teen passengers were sitting in the backseat versus 7 percent of young adults

45 percent of teens sustained severe injury versus 35 percent of young adults; 35 percent of teen sustained head injury versus 23 percent of young adults

Among hospitalized teen passenger car occupants

55 percent of unrestrained sustained severe injuries versus 42 percent of restrained

42 percent of unrestrained sustained head injury versus 37 percent of restrained

8 percent of unrestrained were discharged to long-term care versus 3 percent of restrained

Overall, the younger the passenger car occupants were the more severe injuries and the more head injuries they would sustain than the older occupants. However, the seat belt had greater protection for young adults than for the teens.

4. Discussion

Outcomes of this work were presented to the Statewide Traffic Record Coordinating Committee (STRCC). Iowa CODES provided outputs to the State liaison for seat belt legislation; specifically the findings relating to 11-17-year-old children hospitalized by restraint use concerning seat belt use by young people in the backseat.

CRASH OUTCOME DATA EVALUATION SYSTEM
Promising Practice Applications Using CODES Data

Injuries to Booster-Age Children in Kentucky, 2000-2004

Kentucky CODES, 2009
Injury Prevention and Research Center
University of Kentucky College of Public Health

Abstract

In Kentucky from 2000 to 2004, children 4 to 8 who were restrained in a child safety seat (CSS) were 40 percent less likely to be hospitalized than those who were not. These same individuals also had lower hospital charges, a shorter length of stay in the hospital, and an overall injury severity score lower than others.

1. Project Purpose

This research was conducted to prepare information that could be used by the Kentucky booster seat coalition to educate legislators and the Governor's Executive Committee on Highway Safety. Historically in Kentucky, the majority of children of booster seat age (typically between 4 and 8) who should be restrained in booster seats, have not been. It was hypothesized that such children would show worse crash outcomes than children who were restrained in seats appropriate for their ages.

2. Methodology

Data Used

2000–2004 linked and multiply imputed Kentucky CODES data were used for this research.

Procedure

Using the linked, imputed data, outcomes for children 4 to 8 who were restrained in child passenger safety seats were compared to outcomes for those who were not restrained in CSS.

3. Results

Children who were restrained in CSS were 40 percent less likely to be hospitalized than those who were not. In addition, those same children also had lower hospital charges, a shorter length of stay in a hospital, and a lower overall injury severity score.

4. Discussion

Findings were presented at the 2007 Kentucky Lifesavers Conference. Fact sheets were used by Booster Coalition representatives during the 2008 legislative session as an educational resource for the legislature. The Kentucky legislature passed a booster seat bill during the 2008 General Assembly that applied to children 4 to 7. The law went into effect on July 15, 2008.

The Kentucky Booster Seat Coalition continues to work to ensuring that there is adequate enforcement behind the new law. Following adoption of the booster law, Kentucky State Police added a code specifically for booster seats to the crash database. Also, effective January 1, 2008, the Kentucky Hospital Association began collecting data on emergency department visits from all hospitals. Kentucky CODES plans to repeat the analysis in the future in light of new data developments. The goal is to be able to track the impact of the new booster seat law using Kentucky CODES data.

CRASH OUTCOME DATA EVALUATION SYSTEM
Promising Practice Applications Using CODES Data

Maine Motorcycle Crashes: Causes and Injury Outcomes

Maine CODES, 2009
Maine Health Information Center

Abstract

The Maine Health Information Center conducted a study of the causes and injury outcomes for motorcycle crashes using linked crash-hospital data. Causes were examined separately for crashes involving a single motorcycle vs those involving a motorcycle and another vehicle.

1. Project Purpose

This data analysis was requested by the Maine CODES Advisory Committee including the management of Bureau of Highway Safety, Department of Transportation, Bureau of Motor Vehicles, and the Maine Injury Prevention Program. The State has continued to see an increase in the number of crashes involving motorcycles and wanted the research team to provide a detailed description of motorcycle crash causes and injury outcomes.

2. Methodology

Data Used

The analysis used 2003-2006 linked Maine crash and hospital data.

Procedure

Single-vehicle motorcycle crashes were distinguished from multi-vehicle crashes. For multi-vehicle crashes, characteristics and behavior of both the motorcyclist and the driver of the other vehicle were evaluated. Injury outcomes were measured by body region and severity using the linked hospital inpatient and outpatient emergency department data and applying the ICDMAP-90 injury classification and scoring. The effect of helmets on reducing head injury was evaluated using a multivariate model.

3. Results

Half of the motorcycle crashes were single-vehicle (i.e. did not involve another vehicle) and half were collisions with another vehicle. Contributing factors included: road speed limit, curve in the road, riding at night, younger operators, operator inexperience, illegal or unsafe speed, alcohol or drugs, or lack of motorcycle license permission. Drivers of other vehicles in collisions with a motorcycle were reported as being very young or very old, in violation, failing to yield right of way, making a left turn, and being distracted or inattentive. Motorcycle riders represented 1 percent of all persons involved in crashes and 10 percent of persons requiring hospital care based on the linked data. Results showed that motorcycle riders sustained significant and often multiple injuries; wearing a helmet helped reduced the risk of head injury.

4. Discussion

An in-State presentation was made to the Maine Transportation Safety Coalition. The report was posted to the Maine CODES Web site, provided to CODES Advisory members, and members of other State organizations involved in traffic safety, injury prevention, or hospital care. LD 437 “An Act to Require a Person Under 18 Years of Age to Wear a Helmet While on a Motorcycle” was passed by the Maine legislature in 2009. Additional information, not in the report, was requested tabulating day of week by time of day to assist in planning enforcement efforts, comparing injury outcomes for operators and passengers, and comparing motorcycle injury outcomes with non-motorcycle injury outcomes.

CRASH OUTCOME DATA EVALUATION SYSTEM
Promising Practice Applications Using CODES Data

Paint a Picture of Maryland's Impaired Driving Dilemma

Maryland CODES, 2009
National Study Center for Trauma and EMS, University of Maryland Baltimore

Abstract

Beginning from the formation of the Governor's Task Force to Combat Driving Under the Influence of Drugs and Alcohol (DUI Task Force), the National Study Center for Trauma and EMS (NSC) CODES project served as the State's expert resource for providing persuasive data analysis, documentation, and interpretation using social math techniques. Datasets were linked for descriptive analyses and interpreted results provided to community lobbyists throughout the 2009 legislative session resulting in three DUI laws being passed through the legislature.

1. Project Purpose

Under the hand of the Governor of Maryland, the Task Force to Combat Driving under the Influence of Drugs and Alcohol was formed in July 2007. The DUI Task Force reviewed what MD had been doing to combat the impaired driving issue over the past 20 years, reviewed data to identify where the trends were heading, and began to research nationally recognized best practices for consideration and adoption in Maryland. The newly formed DUI Task Force made recommendations on new initiatives and possible legislation aimed at all impaired drivers, including those responsible for the most fatalities, such as repeat offenders, underage drinkers, and drivers with blood alcohol levels of .15 percent or higher.

2. Methodology

Data Used

Maryland CODES data linking Police crash report data, citation data, and motor vehicle licensing data were used to create the data analyses.

Procedure

Datasets were linked for descriptive analyses.

3. Results

In the 2009 legislative session, after the DUI Task Force submitted its report to the Governor in October 2008, 15 bills were introduced. Three bills were passed by the legislature that the NSC had a direct connection in providing persuasive data analysis, documentation, and interpretation through the use of social math techniques for all 15 bills being introduced.

4. Discussion

At the first gathering of the DUI Task Force in July 2007, NSC staff was brought in as data experts. NSC was tasked with defining and explaining the problem that lay before the group by using tables, graphs, and talking points. After the initial meeting, the NSC continued to be called upon for consultation and data to graphically depict and explain the DUI problems using social math to explain Maryland's problems. Throughout the FY '09 legislative session, the NSC provided data daily to members of the DUI Task Force and Impaired Driving Coalition for use in presenting and testifying before legislators. The NSC continues to work closely with the MHSO and other coalitions from across the State in an attempt to educate them on risk and protective factors of Maryland drivers; to explain and document interventions that can influence change to reduce crashes leading to injuries and fatalities on Maryland's roadways.

CRASH OUTCOME DATA EVALUATION SYSTEM
Promising Practice Applications Using CODES Data

Hospital Charges and Payer Sources for Older Driver Crashes

Massachusetts CODES, 2009
University of Massachusetts Traffic Safety Research Program

Abstract

Linked Massachusetts crash and hospital data were analyzed to better understand hospital charges – and specifically payer sources – for vehicle occupants in older driver crashes.

1. Project Purpose

Massachusetts State agencies have expressed an ongoing interest in the impact of older drivers on safety. Most recently, interest has been focused on licensing policy and opportunities for State-level initiatives to improve older driver safety through policy and programming. Support for State initiatives examining older driver safety.

2. Methodology

Data Used

This analysis used linked Massachusetts crash and hospital data for 2005 (most recent year available at time of analysis).

Procedure

Drivers involved in crashes involving at least one older driver were categorized by age and older drivers (65 to 98) were analyzed against a comparison group (25 to 49). Median charges were examined by driver age group (older versus comparison), sex, and payer source (private, public, or self).

3. Results

There are less notable differences across payer sources between the older driver and comparison groups than might have been expected given the availability of public insurance for older drivers. The results also pointed to noteworthy differences between charges associated with males and females.

- Though most older drivers are eligible for public insurance (Medicare), the great majority of older drivers included in the analysis dataset were covered by private insurance.
- For all three payer source types (private, public, and self), more older female drivers were injured than older male drivers and the median emergency department charges for females were higher than for males. This is different than for the comparison group.

Median emergency department charges were higher for older drivers than for the comparison drivers for all combinations of payer source and sex except self-pay males. For all three payer sources, the difference in median emergency department charges for the older drivers versus comparison drivers was greater for females than males.

4. Discussion

Research report is complete including summary of findings, tables, and graphs.
www.ecs.umass.edu/masssafe/CODES%20WEBSITE/Older_Occupants_Paper.pdf
Currently in process of preparing fact sheet.
www.ecs.umass.edu/masssafe/PDFS%20for%20Site/older%20driver_handout.pdf
Older driver safety continues to be a topic of great interest to State agencies, especially at the Registry of Motor Vehicles. It is anticipated that this information will continue to be used and will serve as the foundation for future analyses and information requests from these agencies.

CRASH OUTCOME DATA EVALUATION SYSTEM
Promising Practice Applications Using CODES Data

Using CODES Data to Support Passing of the Primary Seat Belt Law in Minnesota

Minnesota CODES, 2009
Minnesota Departments of Health and Public Safety

Abstract

The Minnesota CODES team analyzed the relationship between seat belt use and hospital-related outcomes, primarily hospital charges, in support of primary seat belt legislation, which was signed into law during the 2009 legislative session.

1. Project Purpose

The Office of Traffic Safety in the Minnesota Department of Public Safety and the Minnesota Safety Council asked the Minnesota Department of Health to use CODES data to compare belt use with injury outcome and hospital charges, especially considering public payers. Support efforts to upgrade the seat belt law to primary enforcement.

2. Methodology

Data Used

Analyses used 2004-2005 CODES imputed linked crash and hospital data.

Procedure

An analysis data set of passenger vehicle occupants was created, imputing missing values with IVEware. Belt use was compared to median hospital charges, injury severity score, occurrence of traumatic brain injury, mean length of stay and pay source. Multivariate analyses investigated the effect of belt use on hospital charges adjusting for airbag deployment, alcohol relatedness, vehicle age, ejection, person age, gender, seating position, pay source, urban versus rural jurisdiction, location of impact, and month of crash.

3. Results

Not being belted was found to be associated with higher injury severity scores, higher median charges, and longer mean length of stay. The adjusted mean hospital charge for unbelted occupants was $416 compared to $220 for belted occupants. Applying the preventable fraction of hospital charges to total hospital charges resulted in an estimated savings of over $11 million per year, including a savings of $800,000 to Medicaid, assuming the primary seat belt law would result in a belt use rate of 95 percent.

4. Discussion

A working document of prose, tables, and data-driven messages was compiled. The Minnesota Seat Belt Coalition incorporated some of these results into a fact sheet and key Public Safety and Health Department staff referred to these findings while advocating for the change in legislation.
The Minnesota governor signed the Kathryn Swanson Seat Belt Safety Act on May 21, 2009, upgrading the seat belt law to primary enforcement and making Minnesota the 29th State to pass primary seat belt legislation. According to a local news station, lawmakers said the primary law passed this year for two reasons: cuts to health care and this being the last year Minnesota is eligible for $3.4 million in Federal funds by passing the bill.

CRASH OUTCOME DATA EVALUATION SYSTEM
Promising Practice Applications Using CODES Data

Estimated Increase in Number of Head-Injured Motorcyclists and Program Costs if the Motorcycle Helmet Law Is Weakened

Missouri CODES, 2009
Bureau of Health Informatics, Section of Epidemiology for Public Health Practice, Division of Community and Public Health, Missouri Department of Health and Senior Services.

Abstract

CODES data were used to estimate the increase in TBIs and the number of TBI patients added to the Department of Health and Senior Services Adult Head Injury Program if a bill to weaken the helmet law was passed. This was to provide estimates of cost for the bill's fiscal note.

1. Project Purpose

Manager of the Adult Head Injury Program asked for estimates of the increase in TBIs and TBI patients that would be added to her program if the bill to require helmet use only in cyclists under 21 was passed. This was to provide cost estimates for the fiscal note for the bill, for the manager of Adult Head Injury Program and Missouri Legislators.

2. Methodology

Data Used

CODES data for 2004 and 2005 combined (HP crash records linked to inpatient, E/D and mortality records).

Procedure

Using CODES data, the average annual number of TBIs per helmeted and unhelmeted riders 21 and over was determined. Based on the experience of other States, it was estimated that TBIs would increase 50 percent if helmet use was required for those under 21 only. The formula 'new helmet-use rate divided by current rate x current TBIs = estimated TBIs' was applied to helmeted and unhelmeted riders age 21 and over to determine extra TBIs if the law was passed. (For example, for unhelmeted riders: (50% / 7%) X 19 =136 TBIs; current TBIs for this group is 19, and 136-19 = 117 additional TBIs). This number was related to the number of annual additions to the Adult Head Injury Program and their costs per patient to estimated added costs to our department.

3. Results

It was estimated that for helmeted riders the increase would be -70, which gave an overall estimate for helmeted and unhelmeted riders of 117-70 =48 total additional TBIs per year. This was estimated to increase the program patients by 3 per year at a cost of $6434/patient or $19,300.

4. Discussion

Attached to fiscal note and forwarded to legislative staff. The bill was voted down *last year.* A slightly modified bill passed this year (2009) and is being studied by the governor. Additional CODES data has been sent to his staff.

CRASH OUTCOME DATA EVALUATION SYSTEM
Promising Practice Applications Using CODES Data

Adverse Weather-Related Crashes in Nebraska

Nebraska CODES, 2009
Nebraska Department of Health and Human Services

Abstract

This study used 2004-2006 imputed Nebraska CODES data to describe crashes that occurred under adverse weather conditions. Contribution factors were identified to help design prevention strategies and policies to reduce occurrence, injury severity, and economic loss of such crashes.

1. Project Purpose

The work for this project was meant to educate the public extra risks and tips to prevent crashes when driving under extreme weather conditions and was planned in conjunction with the State Highway Safety Office. Target audience: Nebraska drivers, universities, public schools, and those who decide "closing" or "keeping open" policies, etc.

2. Methodology

Data Used

Imputed Nebraska CODES (linked crash and hospital discharge) data for the year 2004-2006.

Procedure

Weather related conditions were defined based on weather condition and road condition fields in crash data. Descriptive analysis was used to identify characteristics and outcomes of crashes occurred under adverse weather conditions, including driver's contribution factors, level of care, hospital charges, length of hospital stay, and injury severity.

3. Results

One out of four crashes in Nebraska occurred under adverse weather conditions. Illegal or unsafe speed, failure to yield, and disregarding/failure to signal were major identifiable drivers' contribution factors for adverse weather-related crashes. Adverse weather-related crashes were associated with more inpatient care, higher hospital charges and longer hospital stay. However, injury severity did not greatly differ between crashes that occurred under normal and adverse weather conditions.

4. Discussion

Presentations sharing these outputs were made to the CODES advisory committee and Nebraska Advocate for Highway Safety. A fact sheet was posted on the Nebraska Department of Health and Human Services' Web site, www.dhhs.ne.gov/codes/TrafficSafety08/Weather_Snow.pdf. Future plans include creating updated factsheets yearly to help create greater awareness with the public about road safety concerns when adverse weather conditions are involved.

CRASH OUTCOME DATA EVALUATION SYSTEM
Promising Practice Applications Using CODES Data

Effects of Upgraded Child Restraint Law in New York State

New York CODES, 2009
New York State Department of Health, Bureau of Injury Prevention

Abstract

The NY CODES project analyzed crash data to show the UCRL implemented in March 2005 in New York State has been effective in reducing traffic injuries to 4- to 6-year-olds, which safety benefit is largely explained by the increasing usage of the child restraint systems for those child passengers. NY CODES examined the association between the upgraded child restraint law (UCRL) implemented in March 2005 and the population-based traffic injury rate among 4- to 6-year-olds in New York State.

1. Project Purpose

The New York State Bureau of Injury Prevention decided to undertake the project to meet needs of the NYS traffic safety community. There has been a continual effort in the NYS traffic safety community to increase the required age of child restraint use to include 7- and 8-year-olds. It is hoped that demonstrating the effectiveness of the recent legislation for 4- to 6-year-olds will help with this endeavor. Support legislation for standard enforcement of booster seat legislation by providing data based evidence.

2. Methodology

Data Used

This analysis used New York Accident Information System (AIS) data, linked crash and hospital data, and census data for the years 2003-2007.

Procedure

The adjusted rate ratio (aRR) of injury between pre- and post- implementation of the UCRL was estimated for 4- to 6-year-olds, as well as for birth to3-year-olds as comparison age group, using the Poisson regression model and monthly injury count data.

3. Results

Children 4 to 6 years old experienced a 15 percent reduction in traffic injury rate (aRR 0.85, 95% CI 0.83-0.88) after the UCRL implementation, while the injury rate for children up to 3 years old, who were not directly affected by the UCRL, did not change appreciably (aRR 0.97, 95% CI 0.93-1.02).
Analysis of the crash data revealed that the reduction in injury rate among 4- to 6-year-olds was mainly due to a 72 percent increase in child restraint usage rate after the UCRL implementation (from 29% before UCRL to 50 percent after UCRL). After adjusting for the monthly variation in child restraint usage rates, the UCRL showed no protection effect on injury rate for 4- to 6-year-olds (aRR 1.44, 95% CI 1.27-1.63). This demonstrates the main effect of the UCRL was to increase child restraint use which reduced the number of injuries.

4. Discussion

Presentations were given at CODES Technical Assistance Meeting and 2009 and Traffic Records Forum 2009. A one page summary with be provided to the Governor's Traffic Safety Committee and New York State Association of Traffic Safety Boards. Next year there are plans to use linked crash and hospital data analyzing the child restraint effects on reducing injuries of different body regions (from MAIS scores) to booster-age children.

CRASH OUTCOME DATA EVALUATION SYSTEM
Promising Practice Applications Using CODES Data

The Medical and Economic Impact of Motorized Recreation Vehicle-Related Traumatic Brain Injury in Ohio

Ohio CODES, 2009
Center for Injury Research and Policy, The Research Institute at Nationwide Children's Hospital

Abstract

The goal of this study was to describe the medical and economic impact MRV-related traumatic brain injuries in Ohio, and identify key factors that are associated with the outcome of individuals who sustain moderate to severe TBI.

1. Project Purpose

Ohio ranks among the top third of States in the reported number of all-terrain vehicle-related fatalities. Therefore, MRV-related injuries are a special interest for the Ohio Department of Public Safety.

2. Methodology

Data Used

This analysis used Ohio Hospital data probabilistically linked with Ohio Trauma Registry records for the data years 2003 to 2006.

Procedure

Descriptive information was compiled for all records included in the Ohio Trauma Registry. TBI and non-TBI patients were compared on mean hospital charges, payer status, mechanical ventilation, intensive care unit stay, rehabilitation care, death, substance use behaviors, and protective safety equipment use. Descriptive data were highlighted for MRV riders and regression analyses were conducted on this MRV subgroup.

3. Results

Motor vehicle crashes and falls account for the majority (65%) of TBI cases in Ohio, while MRVs are associated with slightly less than 5 percent of TBIs statewide. The average annual hospital charges in Ohio for TBI and MRV-related TBI are approximately $241,081,000 and $10,461,000, respectively. TBI occurs to individuals of all ages; however, among trauma patients, younger individuals are more likely to sustain a TBI than older individuals. This is especially the case for MRV-related TBI. Hospital charges are greater for TBIs than non-TBIs. Substance use and protective safety equipment use are associated with TBI outcome. Alcohol use increases the likelihood of a TBI among injured MRV riders. Helmet use reduces the likelihood of a TBI among injured MRV users. We recommend a combination of education and legislative action to decrease the morbidity and mortality due to MRV-related TBI in Ohio.

4. Discussion

A formal report and brief brochure with tables, graphs, and an outline of key findings were disseminated to the Ohio Department of Public Safety. The report and summary are posted on the Center for Injury Research and Policy Web site (http://injuryresearch.net/codes.aspx). Initial analysis was expanded to include all roadway injury events. A manuscript describing these findings was accepted for publication in a peer-reviewed academic journal.

CRASH OUTCOME DATA EVALUATION SYSTEM
Promising Practice Applications Using CODES Data

Building a CODES Coalition in South Carolina

South Carolina CODES, 2009
South Carolina Budget and Control Board, Office of Research and Statistics (ORS)

Abstract

Collaboration and shared responsibility are essential elements in the effort to reduce injuries and fatalities on South Carolina's roadways. Since 1998 South Carolina has built strong relationships with key CODES stakeholders; the ORS is looking now to expand the use of CODES through coalition building with entities beyond that of the grant partners.

1. Project Purpose

The efforts of this work were focused on increasing the awareness, availability, and dissemination of CODES linked data beyond the present grant partners and enhance the linkage with additional data sources (i.e., DMV driver data, EMS as available, roadway information). It is hoped that through coalition building with additional traffic safety stakeholders, greater focus will be given across South Carolina to reducing injuries and fatalities on South Carolina roadways.

2. Methodology

Data Used

SC CODES has linked data dating back to 1998; most analysis is performed on the 2001-2006 linked/imputed data. It is anticipated that the data will be used to study older drivers (70+) who, in South Carolina, have a crash involvement rate similar to young drivers, but on fewer driven miles.

Procedure

The ORS plans to increase the awareness of the CODES project and set the stage for future South Carolina applications by working with institutions such as the Public Health Institute, the South Carolina Center for Gerontology, and the Clemson University Automotive Safety Research Institute.

3. Results

A traffic safety advocate in SC continues to promote the CODES project on behalf of the ORS and brings together those entities outside of South Carolina government with the ORS. The promotion has brought awareness of the CODES project to such organizations as Metropolitan Planning Organizations, Councils of Government, and the institutions listed above.

4. Discussion

The primary means of dissemination with regard to CODES and its activities will continue to be through periodic TRCC meetings, various traffic safety committee meetings, annual SC Highway Safety Conferences, and publications such as the Strategic Highway Safety Plan and a "Data Cookbook" published by the SCDOT which serves as a guide to the various data systems associated with traffic safety.

CRASH OUTCOME DATA EVALUATION SYSTEM
Promising Practice Applications Using CODES Data

Using CODES Data to Support Primary Safety Belt Legislation

Utah CODES, 2009
University of Utah Intermountain Injury Control Research Center

Abstract

For the 2009 legislative session, Utah CODES analyzed differences in hospital outcomes stratified by whether or not a person was using seat belts and by whether or not he or she was an occupant of a commercial vehicle.

1. Project Purpose

The Coalition for Utah Traffic Safety (CUTS) asked Utah CODES to augment seat belt numbers with hospital information regarding the impact of being unbelted and the influence of commercial vehicles on hospital charges for presentations at legislative hearings.

2. Methodology

Data Used

This analysis used linked Utah crash and hospital data for the years 1999 to 2005.

Procedure

Occupants of motor vehicles covered by the proposed primary seat belt legislation were categorized in two different groups: commercial vehicle versus non-commercial vehicle and public insured versus not public insured. Charges were compared within groups stratified by seat belt use.

3. Results

From 1999 to 2005 the percent of hospital charges for crash participants covered by public insurance rose from 9 percent to 17 percent for both ED and admitted patients. If the analysis is subset to only unbelted occupants then public insurance is responsible for nearly half of all hospital charges.

Commercial vehicle occupants had higher average hospital charges than non-commercial vehicle occupants ($3,876 versus $2,700), however commercial vehicle occupants accounted for less than two percent of all charges.

4. Discussion

The emphasis on commercial vehicles came about after the primary seat belt bill was amended to only apply to drivers who were working. The goal was to show that while this is an at risk population they are only one piece of the puzzle. Tables, graphs, and talking points were disseminated to members of CUTS and other traffic safety advocates for their testimony at legislative committee hearings. Ultimately, the primary seat belt bill was defeated. Utah CODES will update the analysis conducted and provide the results in subsequent legislative sessions.

Virginia CODES Supports DMV's Virginia Highway Safety Office Motorcycle Rider Education Program

Virginia CODES, 2009
Virginia Health Information

Abstract

DMV's Virginia Highway Safety Office's Motorcycle Rider Education Program requested CODES data to support findings in the presentation to over 450 attendees at the Virginia Annual Conference on Transportation Safety (ACTS.) Virginia CODES analyzed motorcycle crash data by fatalities, injuries and hospital outcomes to support the Motorcycle Rider Education Program Presentation.

1. Project Purpose

CODES data was used to support a presentation to Department of Motor Vehicles Highway Safety staff, Virginia and local police departments, transportation officials, educators, researchers, judges, MADD and other stakeholders interested in transportation safety. Following the 80 percent increase in motorcycle fatalities across Virginia (70 in 2006 versus 126 in 2007), Virginia's Motorcycle Rider Education Program presented and sought suggestions and solutions to improve safety for all motorcycle riders. The data was also used to raise awareness of the need to address this alarming increase in fatalities and injuries in Virginia and resulting hospital charges.

2. Methodology

Data Used

This analysis used linked 2006-2007 Virginia crash and hospital data.

Procedure

2006-2007 Virginia CODES motorcycle crash data was extracted from the CODES imputed datasets and converted into easy-to-use Excel spreadsheets with labels and codes translated into laymen's terms for use in analyses by DMV's Virginia Highway Safety Office analysts and decision makers.

3. Results

From the analysis, Virginia CODES learned that there was an increase from 70 to 126 fatalities (highest increase in over 40 years). Outputs also showed that Virginia recognized a 19 percent increase in resulting hospitalizations (588 to 699) and an increase from $27 to $30 million dollars in total hospital charges as a result of the record number single year increase in motorcycle crashes.

4. Discussion

The results of this work were used in the development of Virginia's statewide Motorcycle 411 Media and Awareness Campaign in 2008 and 2009. Full benefit and results of the implementation of the Motorcycle Rider Education Program will be recognized following compilation and analysis of the final 2008 dataset.

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Promoting Back Seat Travel for Children Under 13 years in Connecticut

Connecticut CODES, 2010
Connecticut Department of Public Health

Abstract

The Connecticut CODES project examined the impact of seating positions (front seat versus back seat) and restraint use on injury severity for children. Results were to be incorporated into educational materials and awareness messages to promote back seat travel for children under 13.

1. Project Purpose

The purpose of this project was to understand the effect of seating position on injury severity for children.

Safe Kids Connecticut requested Connecticut specific data to enhance child passenger safety awareness and education initiatives that promote back seat travel for children under 13. Target audiences for the results would ultimately be parents and caregivers who transport children and traffic safety decision makers. Safe Kids Connecticut is a member of the CT CODES Advisory Board.

2. Methodology

Data Used

Linked imputed data of Connecticut crash, inpatient hospitalization and emergency department visits for the years 2000 to 2006 were used.

Procedure

Inclusion criteria were vehicle type of passenger car and light truck; only passengers, and restraint use of none, shoulder belt only, lap belt only, shoulder and lap belt, and child safety seat. The analysis looked at injury severity by seating position (front seat versus back seat) and restraint use.

3. Results

Though about one-third of Children under 13 are seated at the front seat, they are two and half times more likely to suffer severe injuries while seated at the front seat than at the back seat, and result does not change after controlling restraint use. There is no risk of severe injuries or protection by seating position detected for the rest of the population. Almost all children (92%) at the front seat are restrained with shoulder and lap belt (while about half (42%) of children at the back seat are restrained with child safety seat.

4. Discussion

The long term goal is to build public and policy maker support for changing Connecticut's child passenger safety law to require children under 13 years to ride appropriately restrained in the back seat of passenger vehicles. The Connecticut law does not currently address seating position.
Results were shared with CODES Advisory Board and Safe Kids Connecticut. Key results highlighting the differences in injury severity for children traveling in the front seat versus the back seat will be incorporated into education materials and public awareness messages.
Based on experience with other traffic safety issues, Connecticut specific crash and medical data, rather than national data, is more effective for educating and influencing both the general public and decision makers.

CRASH OUTCOME DATA EVALUATION SYSTEM
Promising Practice Applications Using CODES Data

Outcomes in Hospitalized Children for Traffic-Related Injuries

Delaware CODES, 2010
Office of Emergency Medical Services, Division of Public Health, Delaware Health and Social Services

Abstract

Motor vehicle traffic-related injuries are the leading cause of injury /death for Children up to 19 in Delaware. The result of this study is to gather information to understand how motor vehicle traffic-related crashes have impacted Delaware children. Analyses were conducted to compare the hospital charges/costs differences among children by body part, Maximum Abbreviated Injury Scale (MAIS), and seat belt use.

1. Project Purpose

To provide the information of differences between hospitalized children up to 19 from motor vehicle traffic-related injuries.

2. Methodology

Data Used

Delaware linked imputed crash and hospital data for the years 2003-2005 were used in this application.

Procedure

Descriptive statistics were used to compare the crash and injury outcomes for hospitalized children involved in crashes.

3. Results

- 13 out of 1,000 children were injured in traffic-related crashes from 2003 to 2005
- Most children had moderate injury for all age groups
- The top three body part injuries were: head, lower extremity and face/neck
- As the severity of the injury increased, both median charge and cost increased for hospitalized children
- Injured children not wearing restraints were 10 times more likely to die than children wearing restraints during crashes
- For all of the body region injuries, the average hospital charges without restraint were higher than those wearing restraint

4. Discussion

The results of the study were incorporated into a fact sheet that was distributed to CODES stakeholders and highway safety officers. Delaware Crash Outcome Data Evaluation System will provide further analyses on child passengers for continued surveillance with traffic safety partners and stakeholders.

CRASH OUTCOME DATA EVALUATION SYSTEM
Promising Practice Applications Using CODES Data

Promoting Optimal Restraint Use Among Children Under 10 in Georgia

Georgia CODES, 2010
Georgia Department of Community Health, Emergency Preparedness and Response, Injury Prevention Program

Abstract

The Georgia CODES Project analyzed the impact of restraint systems for children under 10 regarding age of occupant and proper use of child safety seats in the transition to seat belts.

1. Project Purpose

The focus of this project was on the effect of proper restraint use and the injury severity outcomes for children. Department of Community Health initially requested State specific data information regarding children up to 4 years old by restraint use and payer group to encourage Medicaid involvement providing child safety seats to Medicaid recipients. After examining the data, the age group was increased to focus and include children from 5 to 9 years old.

2. Methodology

Data Used

This analysis used linked Georgia crash and hospital data for years 2003-2006.

Procedure

Inclusion criteria were children under 10; vehicle type excluding pedestrian, motorcycle, bikes, ATV, farm/construction equipment and go carts. Optimal restraint use was Child Safety Seat (CSS) only for children age up to 8. The analysis also looked at charges grouped either Medicaid or non-Medicaid.

3. Results

This data demonstrated how children are being transitioned early into seat belts by about age 4 and for those admitted to the hospital and/or who died, even earlier than 4 years old. In addition, it was found that there was an increase in abdominal injuries for those restrained in a seat belt only; especially for those 3 to 6. Among children 5 to 9 restrained in a child safety seat, the crash rate for hospitalized or killed was 52.5 compared to those only wearing a seat belt with rate of 66.8 per 1,000 crashes.

4. Discussion

Tables and graphs were disseminated to Department of Community Health (DCH) and other traffic safety advocates. The data was included in the Center for Disease Controls Childhood Injury: Booster seat education and evaluation.

Georgia has expanded their Child Passenger Safety Law, passing to include booster seats in 2004 so that all children under age 6 must be properly restrained in a federally approved child restraint. Medicaid resides in DCH.

Unfortunately there were cuts in the Medicaid budget and a submitted proposal wasn't funded. A CDC grant was awarded that will implement and evaluate policy work focusing on booster seat law education.

CRASH OUTCOME DATA EVALUATION SYSTEM
Promising Practice Applications Using CODES Data

The Effect of Safety Belt Use on Head Injuries Among Crash Victims

Illinois CODES, 2010
Illinois Department of Transportation, Division of Traffic Safety

Abstract

Using the linked 2005 crash and hospital discharge data, this work studied the relationship between belt status and head injuries; in addition, descriptive data on hospital charges, utilization patterns, payment source, and discharge destination were created. Finally analytical models were developed to determine the effect of belt status on head injuries, controlling for demographic, vehicle, and crash characteristics. Results and policy implications of the findings were discussed.

1. Project Purpose

To understand the effect of seat belt use on occupants of passenger cars who were injured in motor vehicle crashes and hospitalized in 2005. Data and information included in this study were head injuries, hospital inpatient charges and utilization patterns, and the health consequences of belted versus unbelted drivers and passengers, controlling for selected demographics.
The Illinois CODES project was initiated by the Division of Traffic Safety (DTS) at Illinois Department of Transportation (IDOT) in cooperation with the Illinois Department of Public Health (IDPH).

2. Methodology

Data Used

Illinois linked 2005 crash records to 2005 hospital discharge records.

Procedure

CODES2000 was used to create five separate multiply imputed data sets of linked records. The imputed linkage results served as the input data set to IVEware to create multiple imputations replacing missing values with estimated values. SAS' PROC MIANALYZE was used to evaluate means and standard errors from the imputed results.

3. Results

Based on the linked data, a total of 5,235 records were identified to be admitted and discharged from Illinois hospitals. Overall mean charge for a traffic injury was $55,588 and average length of stay (ALOS) was 7.0 days. Overall, 31 percent of the crash victims had head injury and belted occupants had significantly lower head injuries than the unbelted occupants (28.5 percent for belted versus 44.1 percent for unbelted). To identify possible determinants of head injuries, belt status, alcohol impairment status, and many other vehicle-related factors and demographic characteristics were tested through logistic regression models. Results and policy implications are discussed.

4. Discussion

Since the CODES project resides at the IDOT, the safety professionals are very interested in financial and medical outcome of the crash injuries.
It has been stated that CODES materials are very useful and informative. Future work will include head injuries resulting from lack of helmet law in Illinois.

CRASH OUTCOME DATA EVALUATION SYSTEM
Promising Practice Applications Using CODES Data

Model-Based Application of the Abbreviated Injury Scale to Police-Reported Crash Injuries

Indiana CODES, 2010
Center for Road Safety, Purdue University

Abstract

Evaluation of crash severities and estimation of crash costs are key elements in evidence-based traffic safety improvement programs. Police records include information on injury severity estimated at the scene either by a police officer or by a medical emergency unit. Upon arrival at a hospital, the accident injuries are examined and documented more thoroughly, thus providing a better basis for cost estimation. Utilizing hospital injury data for prioritization of transportation projects and in other decision-making processes requires linking medical and crash records. Unfortunately, only a modest portion of crash records can be linked to corresponding medical records, even if the person was in fact hospitalized, because missing data hampers the linking process.

A new method is presented that overcomes these difficulties and estimates the expected level of injury of individuals included in all police reported crashes. This is accomplished by developing statistical models based on the linked medical and crash records and by applying these models to the entire crash dataset. One of the fundamental problems to overcome was the selectivity bias presented in the linked data and caused by the injury criteria for directing individuals to hospitals. The purpose of the paper is to present the concept and the development of the new proposed methodology. The method is illustrated with the method's components developed using Indiana linked data and applied to Indiana crash data for years 2005-2006.

1. Project Purpose

This project focused to improve a methodology to estimate cost of crashes for use in safety management decision-making. Indiana Criminal Justice Institute requested a method for evaluating the cost of injuries that used data available through the Indiana CODES.

2. Methodology

Data Used

Research linked Indiana crash and hospital records with remaining unlinked crash reports for 2005-2006.

Procedure

Two models were used to create outputs; one to estimate the probability that a crash report is linked with a hospital record and another for estimating the MAIS (Maximum Abbreviated Injury Scale) injury level in the linked data sample to estimate the probability of MAIS levels for all reported injuries (linked and unlinked). Finally an expected cost of injury can be calculated based on the published MAIS-specific costs.

3. Results

A binary logit model of the link probability was developed using the 2005 and 2006 personal injury records (659,185 injuries reported by police) and police reports linking to hospital records (67,298 linked). Also, an ordered multinomial logit model of the MAIS probabilities was developed using linked police-hospital records. A computational procedure was then applied to the Indiana police data to estimate the MAIS probabilities and the cost of injuries.

4. Discussion

The methods developed for this model may be of great value for advanced analyses evaluating safety impact on some selected strategies but are not intuitive at this point in time for replication by other potential users. This application requires logit models that are "specialized" to grasp the safety effects under consideration.

The method and the estimation results were presented at the Indiana Traffic Records Committee in October 2009. The results were presented at the 2010 Annual TRB Meting and published in the Transportation research Record: Journal of the Transportation Research Board.

CRASH OUTCOME DATA EVALUATION SYSTEM
Promising Practice Applications Using CODES Data

Nonfatal Crash Injury Indicators for Kentucky's Strategic Highway Safety Plan

Kentucky CODES, 2010
Kentucky Injury Prevention and Research Center, University of Kentucky College of Public Health

Abstract

This collection of eight brief reports enables tracking of morbidity as a result of a motor vehicle crash in eight of the emphasis areas from Kentucky's Strategic Highway Safety Plan (SHSP).

1. Project Purpose

The purpose of this application is to support the implementation of Kentucky's Strategic Highway Safety Plan. The intent was to document morbidity, including estimates of long-term disability (LTD), resulting from motor vehicle crashes for certain populations of road users and driving behaviors in Kentucky. Also, there was an effort to call attention to the contribution of unsafe behaviors by certain drivers (aggressive, impaired, distracted driving) to disability in other road users.

2. Methodology

Data Used

For the first year of these reports crash, inpatient, and emergency department data for 2008 were linked.

Procedure

Crashes involving at least one hospital visit were identified for eight emphasis areas: impaired driving, distracted driving, aggressive driving, lane departure crashes, young drivers, occupant protection, commercial vehicles and motorcycles. Separate analyses were conducted for each emphasis area. With respect to LTD, for the first year a simply counting of the number of hospital visits for certain principal diagnoses that are known to have a significant association with LTD, e.g., neck and back sprains and strains, traumatic brain and spinal cord injury, and hip/femur fractures were tracked.

3. Results

In 2008, aggressive and distracted driving crashes resulted in large numbers of hospital visits for other road users, primarily as a result of angle crashes and rear-end collisions. In-lane departure crashes, 80 percent of the hospital visits were made by occupants of the vehicle that left its lane. In all three types of crashes, outpatient visits for sprains and strains of the neck were the most common potentially disabling injury, by a wide margin. Outpatient visits for strains and sprains of the back were also common. For inpatients, traumatic brain injury was a common type of potentially disabling injury.

4. Discussion

In the second year of reporting, using 2009 data, epidemiological research and other data sources will be incorporated to provide more accurate estimates of long-term crash-related disability for each of the identified SHSP emphasis areas.
Reports were submitted to the Kentucky Office of Highway Safety for dissemination.

CRASH OUTCOME DATA EVALUATION SYSTEM
Promising Practice Applications Using CODES Data

Trends of Vehicular Crash Injuries and Hospitalizations: Influence of Age

Maryland CODES, 2010
University of Maryland, Baltimore, National Study Center for Trauma and EMS

Abstract

Recent evidence indicates that newer model year vehicles are associated with a significant reduction in crash mortality. The purpose of this analysis is to examine statewide crash mortality and injury trends over time, by age groups, to examine changes in injury rates and patterns, taking into account the fact that newer, safer vehicles are coming into the overall fleet.

1. Project Purpose

The purpose of this analysis is to examine statewide crash mortality and injury trends over time to examine changes in injury rates and patterns and to analyze injury trends among hospitalized drivers in motor vehicle crashes.

2. Methodology

Data Used

Statewide police crash reports and hospital discharge records for 1997-2006 were obtained as part of the State CODES project.

Procedure

Two types of analyses were presented: one from crash reports and the other based on a linkage between crash reports and hospital discharge records, both for the entire state of Maryland. Statewide police crash reports and hospital discharge records for 1997-2006 were obtained as part of the statewide CODES (Crash Outcome Data Evaluation System) project. Trends in mortality and KABCO scores were obtained from statewide police crash reports. Injury types and severities were determined from a linkage of police crash reports and hospital discharge records. Injuries were described individually by MAIS body region and injury severity by ISS scores. “Serious” injuries were defined as AIS 3+. Trends were examined for three age groups: <20, 21-64, and 65+. Trends for total crashes included all occupants, whereas trends for those hospitalized were based on drivers only, since the linkage is probabilistic and requires date of birth, which is not available for passengers.

3. Results

Significant declines in injury were noted for all age groups. Furthermore, declines were noted both for rates of injuries per population as well as per numbers of licensed drivers. Injury and fatality rates per vehicle mile travelled declined during this period, potentially implying that reductions could be reflective of improvements in crashworthiness of the vehicle fleet.

The number of hospitalizations declined for all age groups. However, among those hospitalized, no significant decline was noted in the mean ISS score. In fact, among drivers 20-64, significant increases were observed in the incidence of injuries to most body regions during this 10-year period (thorax: 28.1%-31.5%; abdomen 13.4%- 16.6%; spine 18.5% - 24.4%; and upper extremities 26.3% - 30.5%). There was no apparent change in the incidence of lower extremity injuries. A significant decline was noted for serious (AIS 3+) head injuries (20.1% -15.3%) in this middle-aged group. For elderly drivers, however (age 65+), an increase was noted for the overall incidence of spinal cord injuries (12.9% -18.8%), and serious (AIS 3+) head injuries (31.4% - 41.3%).

4. Discussion

Further vehicle safety improvements need to focus more on features addressing head and spinal cord injuries among those 65 and older, who will represent an increasing proportion of the driving population as the U.S. population ages.

A comprehensive presentation was given at the proceedings of the Association for the Advancement of Automotive Medicine Annual Meeting, 2010.

CRASH OUTCOME DATA EVALUATION SYSTEM
Promising Practice Applications Using CODES Data

Using CODES Data to Examine Hospital Costs and Frequency Comparisons Associated With Different Types of Collisions

Massachusetts CODES, 2010
University of Massachusetts Traffic Safety Research Program

Abstract

Massachusetts examined the hospital costs associated with different types of crashes, including single-vehicle and various multi-vehicle crashes, to support Massachusetts policies to improve traffic safety by helping inform Massachusetts transportation officials about the types of crashes that result in the most costly injuries.

1. Project Purpose

The purpose of this project was to support Massachusetts initiatives to reduce traffic crashes and injuries. Massachusetts agencies were interested in better understanding the causes behind traffic crashes resulting in driver injuries.

2. Methodology

Data Used: This analysis linked Massachusetts crash and hospital data for the years of 2004 and 2005 (the most recent years with linked data at the time of the analysis).

Procedure: Drivers with linked hospital data were categorized first by manner of collision, and then by secondary categories including driver age, most harmful event and driver contributing factors. Median emergency room and inpatient hospital charges were calculated for each driver group.

3. Results

The single vehicle crash (SVC) manner of collision accounted for 44 percent of crash-related inpatient hospital stays with median charges of $18,128 and 17 percent of emergency room (ER) visits with median charges of $1,007. The median charges for those in SVCs with ER visits were higher than any other manner of collision. The findings for specific attributes for SVCs are outlined below.

Age-related Impacts: Younger drivers in SVCs were more likely to be treated in the ER and then released, whereas older drivers in SVCs were more likely to be admitted. Drivers 16 to 25 comprised 46 percent of ER patients and 33 percent of inpatients after a SVC; in contrast, drivers over 65 accounted for 4 percent of ER patients and 12 percent of inpatients after a SVC. Among drivers admitted as inpatients, young drivers were the most likely to have been in an SVC (60% of those 16-25, compared to 44% for 26-65, and 29% for drivers over 65). ER median costs were higher for every age group in SVC than multi-vehicle crashes.

Most Harmful Event: Fifty-three percent of all SVCs resulting in inpatient stays and 48 percent of all SVCs resulting in ER visits involved collisions with trees or light utility poles with median inpatient stay charges of $18,725 and median ER visit charges of $1,097.

Driver Contributing Factor: The percent of crashes involving a distracted driver has been increasing steadily in Massachusetts from less than 12 percent in 2003 to almost 18 percent in 2009*. Interestingly, in 2009, 23 percent of drivers in single-vehicle crashes were reported to be distracted compared to 14 percent of drivers in other crash types. SVC distracted drivers accounted for the highest percent of driver contributing factors in crash-related ER visits (19%) with median charges of $963.

4. Discussion

Further analysis of the CODES data for single-vehicle crashes is planned. The analysis will be updated using newer years of linked data once these data are available.

A fact sheet and a more detailed research report were prepared to summarize the findings of the analysis, and shared with the Massachusetts CODES Advisory Board and other State agencies.

(**2009 figures not yet finalized)*

CRASH OUTCOME DATA EVALUATION SYSTEM
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Using CODES Data to Support Additional Mandatory Insurance For Non-helmeted Riders

Minnesota CODES, 2010
Injury and Violence Prevention Unit, Minnesota Department of Health

Abstract

This study examined the potential impact of non-helmet use on hospital charges, generating results in the right direction but with a charge differential that many observers found underwhelming.

1. Project Purpose

The purpose was to estimate hospital charge savings if motorcyclists were helmeted. The Minnesota Department of Public Safety (DPS) and the Brain Injury Association of Minnesota (BIAM) requested the study to support motorcycle helmet legislation.

2. Methodology

Data Used

This analysis used motorcyclists in the linked Minnesota crash and hospital data for the years 2004 – 2005. The specific data set was the motorcycle model data submission with missing values imputed by the CODES Technical Resource Center.

Procedure

At-scene fatalities and non-hospital treated cases were included in the models, both having zero charges. From each of the five imputations relevant variables were identified by stepwise selection, resulting in four unique sets of covariates. The four models were run on each imputation, combining the results with PROC MIANALYZE. Differences in least square means were assessed for helmet use, speeding and alcohol/drug impairment.

3. Results

Helmet use appeared in only three of the four models identified, being replaced by speeding in the other two models. In the models including helmet use, the cost differential for not wearing a helmet was approximately $1,000 per case. Of the 1,793 patients who were hospital-treated in these two years: 56 percent did not use helmets; 18 percent were speeding; and 13 percent were alcohol/drug impaired. Total hospital charges for the two years were more than $39.6 million. If everyone had worn helmets, a savings of more than $986,000 was projected. If no one had been speeding, a calculated savings of more than $780,000 was projected. And, if no one had been impaired, calculated savings of more than $629,000 was identified. Motorcycle crashes can cause significant injury, with median charges of approximately $4,500 per case. At best, lack of helmet use accounts for 20-25 percent of those charges on a per case basis. Other risk factors, including speed and alcohol use, were found to be just as or more important than the lack of helmet use.

4. Discussion

Focus for future work will be on ways to generate outputs to make a greater impact.
Results were shared with the chief disability advocates lobbyist from BIAM and the motorcycle safety program administrator from DPS.

CRASH OUTCOME DATA EVALUATION SYSTEM
Promising Practice Applications Using CODES Data

Update of Missouri CODES Web Application

Missouri CODES, 2010
Missouri Department of Health and Senior Services

Abstract

The Missouri CODES Web application allows users to develop tables of CODES data. Crash and medical variables are available to create outputs. Seven years of CODES data are now available on the Missouri CODES Web site.

1. Project Purpose

This project was established to provide information on speeding, helmet and belt use, alcohol use, age, and sex of driver as related to health outcomes of death, traumatic brain injury (TBI), ejection and hospitalization, for highway safety professionals, policymakers, legislators, and community leaders.

2. Methods

Data Used

This application allows users to link Missouri crash and hospital data for the years 1996, 1999, 2001 and 2003 to 2006. Only data for drivers is included in the Web site, because in Missouri, data is collected on both the injured and uninjured drivers. Data is collected on passengers only if they are injured, making any comparisons involving them less clear cut.

Procedure

Probabilistic linkage of Missouri State Highway Patrol (MSHP) crash data with emergency department and inpatient Patient Abstract System (PAS) hospital data was conducted using the CODES2000 software. Beginning in 2003, mortality data were also included. Links with a probability of 0.80 and above were included, except for links where the admission date is more than one day earlier than the crash date, or where the admission date is over 30 days after the crash date.

3. Results

The Web application allows users to construct tables relating crash variables to medical care variables. Individuals are able to submit queries to create outputs that correlate various variables such as: percent of helmeted versus unhelmeted motorcycle drivers who die; those who are admitted as inpatients or visit the emergency room; or seat belt usage in relation to medical care, etc.

4. Discussion

In 1993 and 1996, the CODES data were linked with Emergency Medical Services (EMS) data as well as hospital data. The 1993 data are no longer on the Web site, and after 1996, the EMS data were no longer available to be linked using CODES methods, so no EMS data are shown on the Web site. Updates of the linked crash-E/D-inpatient-mortality data are planned for 2007 and 2008 after the data linkages have been completed, during October, 2010.
The Web application is available to anyone with internet access. The Web link is: www.dhss.mo.gov/MICA/index.html (select Motor Vehicle Crash and Outcomes)

CRASH OUTCOME DATA EVALUATION SYSTEM
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Who's Using? Who's Losing? How Nebraska CODES Supported the "Use and Lose" Law

Nebraska CODES, 2010
Nebraska Department of Health and Human Services

Abstract

Nebraska CODES provided injury and hospital charges information related with underage drinking and driving to endorse the "use-and-lose" law during the 2010 legislative session.

1. Project Purpose

Nebraska Office of Highway Safety, Nebraska Safety Council, and Nebraska Injury Surveillance and Prevention Program requested information on injuries and economic cost associated with underage drinking and driving. The purpose of this study was to respond to the requests and to support Nebraska Legislative Bill 258: Change and provide penalties for minors in possession of alcoholic liquor.

2. Methodology

Data Used

2004-2008 Nebraska CODES database (linked crash data and hospital discharge data).

Procedure

Descriptive analysis was conducted to describe characteristics (who, when, where, what, and why) of crashes involving underage drinking and driving. Multi-level modeling was used to examine the impact of underage drinking and driving on crash outcomes (e.g., hospital charges and injury severity).

3. Results

During 2004-2008, 1,796 DUI teenage (13- to 20-year-old) drivers were involved in 1,696 crashes in Nebraska. These numbers represent about 3 percent of teenage drivers and 3 percent of crashes involving teenage drivers. Crashes related to underage drinking and driving involved more male teenage drivers, occurred more during late nights, early mornings, weekends, summer and winter breaks, and in rural areas. Logistic regression and multi-level modeling suggested that when other conditions held constant, DUI teenage drivers' odds of suffering severe injuries are 5 times as high as non-DUI teenage drivers. Underage drinking and driving alone doubled hospital charges for the first admission.

4. Discussion

Results of statistical analysis were provided to related agencies. Study findings were presented at Nebraska CODES advisory committee meeting. A fact sheet was posted to the Nebraska CODES Web site:
http://dhhs.ne.gov/publichealth/Documents/underagedrinkinganddriving.pdf

CRASH OUTCOME DATA EVALUATION SYSTEM
Promising Practice Applications Using CODES Data

Using CODES Data to Support Back Seat Safety Belt Legislation

New York CODES, 2010
New York State Department of Health, Bureau of Injury Prevention

Abstract

New York CODES analyzed hospital outcomes for people 16 and older treated at a New York hospital or emergency department who were not wearing a seat belt in the backseat during a motor vehicle crash. Additionally, these outcomes were compared to backseat passengers 16 and older who were wearing safety restraints.

1. Project Purpose

To assist the NYS Governor's Traffic Safety Committee (highway safety office) in their efforts to support legislation to require backseat seat belt use for persons 16 and older. Currently backseat passengers under 16 are required to wear a safety restraint.
The GTSC requested CODES linked hospital data to supplement seat belt data found in Police Crash Reports. The data was the basis for a one page document that GTSC shared with policy makers and occupant protection professionals.

2. Methodology

Data Used

Data used for this work incorporated 2007 police crash report data linked to hospital data.

Procedure

Analysis was done on motor vehicle passengers 16 and older injured in motor vehicle crashes while riding in the backseats of vehicles.

3. Results

In 2007, every day, an average of 9 New Yorkers 16 and older who were riding in the backseats and not using seat belts were injured, 5 of whom sustained injuries serious enough to require hospital treatment. Treatment of these injuries resulted in over $9 million in hospital emergency department and hospitalization charges, with nearly 10 percent of the hospitalization charges paid with public funds. Unrestrained back seat passengers were 2.9 times more likely to be hospitalized and 1.6 times more likely to be treated at emergency rooms than restrained passengers. Additionally, unrestrained backseat passengers were 2.4 times more likely to incur serious injury (Injury Severity Score >= 4) and 2.5 times more likely to sustain traumatic brain injury.

4. Discussion

At the time this document was prepared, no decision had been made on the New York bill. If the legislation does not pass, additional analyses will be performed to strengthen the argument in the future. A one page summary was provided to the GTCS who provided it to their legislative liaison to use to try to convince legislators to pass a bill that would require the use of back seat seat belts for those 16 and older.

CRASH OUTCOME DATA EVALUATION SYSTEM
Promising Practice Applications Using CODES Data

Motorcycle-Crash-Related Injuries in Ohio, 2005 to 2007

Ohio CODES, 2010
Center for Injury Research and Policy, the Research Institute at Nationwide Children's Hospital

Abstract

Motorcycle injuries are of special interest to the Ohio Department of Public Safety. The intent of this study was to educate traffic safety decision makers about key factors associated with the medical and economic outcome of motorcycle-crash-related injuries in Ohio.

1. Project Purpose

The goal of this study was to describe key factors associated with outcome of individuals who sustain motorcycle-crash-related injuries in Ohio.

2. Methodology

Data Used

This analysis used Ohio Crash data probabilistically linked with Ohio hospital records for the data years 2005 to 2007.

Procedure

Descriptive information was compiled for all motorcycle records included in the Ohio crash database and for hospital records that linked to the crash database. Injured and non-injured motorcycle riders were compared on factors related to the crash occurrence. Helmeted and non-helmeted motorcycle riders were compared on injury severity assessments, discharge status, LOS, and average inflation-adjusted hospital charges.

3. Results

In 2005 to 2007, there were 15,467 motorcycle riders involved in crash-related incidents in Ohio. Both male and female riders were on average 40 years old, and the majority of motorcycle riders (84.4%) were male. An injury occurred for 79.3 percent of riders involved in a crash-related incident. Helmet use was reported for 6,607 riders, and 41.9 percent of injured motorcycle riders were wearing helmets at the time of the crashes. Among people with a traumatic brain injury, 72.6 percent were not wearing helmets at the time of the crash. Median hospital charges for helmeted and non-helmeted motorcycle riders with a documented TBI were $14,014 and $16,620, respectively. Average length-of-stay for surviving motorcycle riders with documented TBI was 3.86 days for helmeted riders and 4.80 days for un-helmeted riders. There were 440 motorcycle riders who died at the scenes or during hospital care.

4. Discussion

The broader impact of this project is yet to be determined. The Ohio CODES team selects topics of interest for the entire traffic safety community, with a special focus on legislators and other policymakers. One potential goal of this project is to have a universal motorcycle helmet law introduced in the Ohio legislature.

A formal report and brief brochure with tables, graphs, and an outline of key findings will be disseminated to the Ohio Department of Public Safety, other key stakeholders in Ohio and nationally upon completion of the project. A report and summary will also be posted on the Center for Injury Research and Policy's Web site, www.nationwidechildrens.org/Document/Get/103706

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The Effect of Mandatory Seat Belt Use Law on the Medical and Financial Outcomes of Persons Involved in Crashes in South Carolina

South Carolina CODES, 2010
South Carolina Budget and Control Board, Office of Research and Statistics

Abstract

South Carolina's CODES linked data was used successfully in 2005 to support stakeholder efforts in the passage of mandatory seat belt use legislation. Subsequent years of CODES data has been linked enabling a comparison of the medical and financial outcomes of persons involved in crashes in South Carolina since the passage of South Carolina Code of Laws § 56-5-6520, "Mandatory use of seat belts."

1. Project Purpose

A mandatory seat belt use law can lessen the severity of injuries suffered and result in lower hospital charges. In conjunction with the South Carolina Department of Public Safety, Office of Highway Safety, this analysis was done to determine the extent to which the mandatory seat belt use law has prevented injuries, lessened injury severity, and/or reduced the total and average hospital charges.

2. Methodology

Data Used

South Carolina linked crash and hospital (ED and inpatient hospitalizations) as follows:

- 2003 and 2004 SC CODES data for pre-legislation analysis, and
- 2006 and 2007 SC CODES data for post-legislation analysis.

Procedure

The original analysis used high probability links and looked at hospital charges by primary pay source, level of care (ED versus inpatient hospitalization), and length of stay. This analysis focuses on the 2006-2007 multiply imputed data, as well as revisits the 2003-2004 data - this time employing the multiply imputed links, and looks at the same medical and financial outcomes. The outcome variables are stratified by motor vehicle occupant seat belt use.

3. Results

The mandatory seat belt law has resulted in fewer severe injuries and less injuries overall. Analysis of hospital charges pre- and post-legislation showed a significant 'savings' far beyond the predicted $11M from the 2005 analysis: total hospital charges were $38,173,725 less in the two years following the legislation. Further, there was an overall cost savings for all occupants of $187,857,995 in the same two year period, post-legislation.

4. Discussion

The same before and after methodology can be applied to the use of helmets for motorcyclists as will be done with this study. Critical information can be gleaned from such work providing a State such as South Carolina which does not have a helmet law with new insight. The improvement in seat belt use, the reduced injury severity, and the savings in terms of hospital charges may be influential in passing a mandatory helmet law.

CRASH OUTCOME DATA EVALUATION SYSTEM
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Using CODES Data to Support Utah Senate Bill 113, Wireless Telephone Use Restriction for Minors in Vehicles

Utah CODES, 2010
University of Utah, Intermountain Injury Control Research Center

Abstract

During the 2010 legislative session, Utah CODES provided linked crash and hospital statistics to traffic safety advocates and legislators for crashes involving teen distracted driving.

1. Project Purpose

The purpose of this study was to support Utah legislative efforts to prohibit cell phone use among teen drivers 15 to 17 years old while operating a motor vehicle.
The Coalition for Utah Traffic Safety (CUTS) and other safety advocates asked the Utah CODES program to provide statistical support regarding distracted driving among teens using probabilistically linked data from Utah crash reports and hospital records.

2. Methodology

Data Used

Analyses were conducted using the 2006 linked Utah CODES database to assess the medical and financial impact of teen distracted driving.

Procedure

Summary statistics were computed to demonstrate the impact of teen distracted driving. These statistics included number of teens distracted by cell phones or other electronic devices, injury levels of those involved, number of hospital visits, total days spent in the hospital, and total amount charged from hospital visits.

3. Results

In 2006, 773 crashes resulted from teen distracted driving. Cell phones or other electronic devices were reported to have been a factor in 118 of those crashes.
Of the crashes associated with a driver distraction of cell phone or other electronic device, 1 person was killed, 3 people experienced incapacitating injuries, 27 people experienced non-incapacitating injuries, and 48 people experienced possible injuries. These injuries resulted in 42 emergency department visits and 2 inpatient (IPT) visits, 24 total days of hospitalization, and combined total ED and IPT charges of $240,000.

4. Discussion

The results were presented in a fact sheet that was made available for safety advocates to use in discussion with legislators. Additionally, Utah CODES staff was invited to present and discuss findings at an educational session held at the Utah State Capitol at the start of the 2010 legislative session. The fact sheet was also posted to the Utah CODES Web site and can be found at www.utcodes.org/publications/factSheets.html.
Ultimately, following much debate and many amendments, SB 113 was defeated. Plans are already underway to introduce the legislation again next year. Since the end of the legislative session both 2007 and 2008 data years have been linked and will be able to shed further light on the topic of teen distracted driving in Utah.
Distracted driving is a concern for drivers of all ages; however, due to the political climate, legislators chose to focus specifically on teens. In preparation for a more comprehensive distracted driving bill, fact sheets have been updated to include all drivers.

Using CODES Data to Support Child Restraint Legislation

Virginia CODES, 2010
Virginia Health Information

Abstract

During the 2010 Virginia General Assembly legislative session, Virginia CODES supplied data to Department of Motor Vehicle Office of Highway Safety to successfully support the restraint law bill SB219 to raise the age for wearing restraint in the back seats to 18.

1. Project Purpose

CODES data was used to support legislation requiring the use of restraints for those persons riding in the back seat of a vehicle and increasing the age to 18 years old. CODES data was used to augment the involved, injuries and fatalities from the VA Highway Safety Office at DMV. Janet D. Howell, patron of SB 219, requested information from DMV's Virginia Highway Safety Office (VAHSO). Total charges and length-of-stay data were extracted and detailed into three age categories - 16, 17, and 18 years old.

2. Methodology

Data Used

This analysis linked 2006 and 2007 Virginia crash and hospital data.

Procedure

The 2006 and 2007 Virginia CODES restraint data was extracted from the CODES imputed datasets and provided to DMV's VAHSO in easy-to-use Excel spreadsheets with translated labels and codes for their use.

3. Results

The impact analysis, which focused on unbelted passengers 16 to 18, killed or injured in the back seat in crashes, showed that passengers, particularly female passengers, die or are injured more often in the back seat when they do not use their belts (18%) versus those (9%) who were belted. The hospital charge per year for those fatalities and injuries is $12 million. In fact, the average LOS is 3 days less for belted (6.2 days) than unbelted (9.3 days) passengers and the hospital charge is almost $28,000 higher for non-users of seat belts compared to belt users - $58,800 versus $30,700, respectively. The information was used by the Virginia General Assembly to demonstrate that back seat unbelted passenger fatalities and injuries resulting from traffic crashes continue to be a public health problem. With the information, GA Committee members were able to take the appropriate legislative action needed to contribute toward the goal of reducing fatalities and injuries in crashes on Virginia roads.

4. Discussion

This joint effort contributed to Senate Bill 219 being passed by both the House and Senate and signed into law by the Virginia Governor effective July 1, 2010. Impact analysis was provided to DMV's VAHSO Executives, DMV's Executive Office and DMV's Legislative Office prior to submission to Delegate Howell's office for dissemination to members of the Senate Transportation Committee and the House Militia, Police and Public Safety Committee.

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Characteristics of Connecticut Crashes in Rural Versus Non-Rural Settings

Connecticut CODES, 2011
Connecticut Department of Public Health (DPH)

Abstract

The Connecticut CODES Project examined the differences between crashes that occurred in rural versus non-rural settings. Results will be incorporated into educational materials and awareness messages and to guide resource allocation for traffic safety in rural communities.

1. Project Purpose

The Connecticut DPH Injury Prevention Program, the DPH Family Health Section, and the Connecticut Office of Rural Health collaborated on a rural motor vehicle injury prevention initiative. An analysis by the Injury Program, using mortality and hospitalization data, showed a higher motor vehicle death and injury rate among rural area residents. Limitation of this study was it was based on the crash victim's residence and not where the crash occurred. Therefore, data was requested on the characteristics and factors associated with rural crashes to see if they resulted in more serious outcomes than those in non-rural areas. This information would be used to guide prevention and awareness activities.

2. Methodology

Data Used

Linked imputed data of CT crash, inpatient hospitalization, and ED visits for the years 2000 to 2007.

Procedure

The analysis looked into characteristics and factors associated with rural crash ED discharge status; crash type and manner of collision; road conditions; speeding; driver impairment; driver and passenger age, restraint use and injury severity to compare with non-rural crashes to determine if rural crashes resulted in more serious outcomes.

3. Results

Compared to non-rural crashes, drivers and passengers in rural crashes were about three times more likely to die from their injuries. Rural crashes were more than twice as likely as urban crashes to involve only a single vehicle; to involve icy road conditions or to have speeding or driver impairment as contributing crash factors; and nearly 3.5 times more likely to involve driver fatigue. Drivers and passengers in rural crashes are less likely than their counterparts in non-rural crashes to have used restraints, and rural crashes are more likely to involve teen drivers and passengers. In rural crashes, speeding, driver impairment, and no restraint use all resulted in a greater likelihood of ED/hospital admission or death. The highest percentage of drivers and passengers in rural crashes who died or were admitted to the ED/hospital was in the 16-to-19-year-old age group; and the crashes were more likely to have occurred during the hours of midnight to 6 a.m.

4. Discussion

Results will be shared with the rural injury partnership, including the Connecticut Office of Rural Health, Connecticut Department of Transportation, and other CODES Advisory Board members, through fact sheets, charts, and graphs.

Information on factors and characteristic of rural crashes will be incorporated into educational materials and awareness messages and to potentially guide decision makers on traffic safety resources allocated to Connecticut 's rural communities.

Based on Connecticut Vital Statistics and Uniform Hospital Discharge Data sets, motor vehicle crash mortality and hospitalization rates were higher for Connecticut rural area residents. However, these data sets cannot be used alone to make any conclusions about crashes actually occurring in rural communities.

CRASH OUTCOME DATA EVALUATION SYSTEM
Promising Practice Applications Using CODES Data

Injury Analysis of Delaware Alcohol-Impaired-Driving Crashes

Delaware CODES, 2011
Office of Emergency Medical Services, Division of Public Health, Delaware Health and Social Services

Abstract

Using CODES data to analyze the hospital charges/costs in alcohol-impaired-driving crashes, a fact.sheet was developed and distributed to Delaware Impaired Driving Assessment. The fact sheet information contributes to the efforts in preventing injuries, saving lives, and reducing economic costs of motor vehicle crashes on Delaware's roadways.

1. Project Purpose

The purpose of the project was to provide information on differences on hospitalized occupants involved in alcohol-impaired driving as requested by the Delaware Office of Highway Safety. The audiences included Highway Safety, EMSC, and Injury Prevention Programs.

2. Methodology

Data Used

Delaware linked imputed crash and hospital data for the years 2003 to 2007 were used in this application.

Procedure

Descriptive statistics were used to compare the crash and injury outcomes for hospitalized occupants involved in alcohol- impaired crashes.

3. Results

- There were 5,431 alcohol-impaired driving crashes that resulted in 895 non-fatal injuries and 155 fatalities from 2003 to 2007.
- Among alcohol-impaired driving crashes more were likely to occur at night (88%) and on weekends (63%).
- The highest percentage of impaired drivers involved in crashes was drivers 25 to 34 (27%), followed by 20 to 24 (24%).
- From 2003 to 2007, the estimated total medical cost for people who were injured in impaired-driving crashes was $12,091,928. Over $39 million was estimated on the State economic cost ($39,032,288) for impaired-driving-related crashes.

4. Discussion

The result of the study was a PowerPoint presentation at a CODES board meeting and in the panel of Delaware Impaired Driving Assessment. The study produced a fact sheet that was distributed to Delaware Impaired Driving Assessment. The study information was displayed on poster at Statewide Highway Safety Conference in October 2011.

CRASH OUTCOME DATA EVALUATION SYSTEM
Promising Practice Applications Using CODES Data

Using Path Models to Determine the Effects of Safety Belt and Alcohol Impairment on Injury Severity and Hospitalization Costs Among Illinois Crash Victims

Illinois CODES, 2011
Illinois Department of Transportation, Division of Traffic Safety

Abstract

Using the linked 2005 Illinois crash/hospital inpatient discharge data, this study intends to decompose the effects of alcohol impairment and seat belts use on injury severity (MAIS score) and hospitalization costs among passenger car occupants of crash victims in a theory-guided manner.

1. Project Purpose

The studied population was all occupants of passenger cars who were injured in motor vehicle crashes and hospitalized in 2005. Data and information included in this study were hospital inpatient charges and the health consequences of occupants of crash victims. The Illinois CODES project was initiated by the Division of Traffic Safety at IDOT in cooperation with IDPH. Results of the linked crash/hospital discharge data were presented to the Illinois CODES Advisory Group, ITRCC, and other safety committees at DTS.

2. Methodology

Data Used

The study used Illinois linked 2005 crash data to 2005 hospital inpatient discharge data.

Procedure

CODES2000 was used to create five separate multiply imputed data sets of linked records. The imputed linkage results served as the input data set to IVEware to create multiple imputations replacing missing values with estimated values. SAS' PROC MIANALYZE was used to evaluate means and standard errors from the PROC MI results. Finally, The TCALIS procedure in SAS was used to calculate path coefficients and several other related statistical parameters.

3. Results

Based on the linked data, 5,235 records were identified to be admitted and discharged from Illinois hospitals. Overall, 31 percent of the crash victims had head injury and belted occupants had significantly lower head injuries than the unbelted occupants (28.5% for belted versus 44.1% for unbelted). To identify possible determinants of head injuries (MAIS score) and their associated hospitalization costs, belt status, alcohol impairment, and many other selected factors including demographic and geographic characteristics, and temporal variables were tested through path analyses. Results and policy implications are discussed.

4. Discussion

Results have been presented to: CODES Advisory Committee; Illinois TRCC; IDPH Data Committee; HSP Committee, and motorcycle safety group at the Illinois Department of Transportation (IDOT). We have been informed by our highway safety program staff that CODES material is very useful and informative. We are planning to replicate this study using the linked 2009 crash/hospital inpatient and ED data when we complete the linkages sometime this year. Since the CODES project is resided at the IDOT where the highways safety programs are, the highway safety professionals are very interested in financial and medical outcome of the crash injuries.

CRASH OUTCOME DATA EVALUATION SYSTEM
Promising Practice Applications Using CODES Data

Using CODES Data to Estimate the Burden of Cervical Sprain and Strain Injuries Resulting from Motor Vehicle Crashes in Kentucky

Kentucky CODES, 2011
Kentucky Injury Prevention and Research Center, University of Kentucky College of Public Health

Abstract

This report documents the incidence of acute cervical sprain and strain injuries resulting from motor vehicle crashes in Kentucky, and provides estimates of the long-term impact of those injuries in terms of disability and direct medical costs.

1. Project Purpose

The purpose of this application is to call attention to the considerable burden of nonfatal traffic injuries on the population of Kentucky by highlighting the long-term impact of the most common example of such injuries, namely sprains and strains of the cervical spine resulting from whiplash. This project is funded, in part, by a grant from the Kentucky Office of Highway Safety. The target audience is traffic safety policy- and decision- makers.

2. Methodology

Data Used

We used linked crash, inpatient, and emergency department data for 2008 and 2009.

Procedure

We conducted an analysis of peer-reviewed epidemiological studies on the prognosis of ED patients treated for cervical sprains and strains resulting from traffic crashes. The constellation of short-term symptoms that typically results from such injuries is referred to as "acute whiplash-associated disorder" (WAD). Based on the findings of those studies we estimated the twelve-month risk that a person diagnosed in a Kentucky ED with acute WAD following a traffic crash would become chronic (mean that symptoms did not resolve within twelve months). We then applied that risk estimate to Kentucky's CODES data to generate estimates of the incidence of acute WAD, the prevalence of chronic WAD, and the annual direct medical costs associated with treatment of chronic WAD, among Kentucky residents. We used the ICD-9-CM code 847.0, "Sprains and strains of neck," to identify baseline cases of acute WAD.

3. Results

We estimate that 30 percent of persons diagnosed in Kentucky ED's with acute WAD will become chronic over the course of twelve months, meaning that they will experience persistent long-term symptoms that interfere with leisure and/or work activities. Furthermore, we estimate that 10 percent will experience chronic work-related impairments.

Currently we are applying these risk figures to Kentucky's CODES data to estimate the annual incidence of new cases of chronic WAD in Kentucky's population resulting from traffic crashes, as well as the overall prevalence of existing cases and the annual direct medical costs attributable to the condition. This abstract will be updated when those numbers have been finalized.

4. Discussion

The reports will be submitted to the Kentucky Office of Highway Safety, which will determine how they will be disseminated.

CRASH OUTCOME DATA EVALUATION SYSTEM
Promising Practice Applications Using CODES Data

Correlation of Police Perception of Alcohol Use as Coded on the Crash Report and Hospital-Based BAC Testing Results in Maryland.

Maryland CODES, 2011
National Study Center for Trauma and EMS, University of Maryland Baltimore

Abstract

Often when drivers of motor vehicles are involved in a fatal crash, circumstances preclude the officer at the scene from obtaining valuable field sobriety test or breathalyzer results. Additionally ERs are unable to collect blood alcohol concentration (BAC) information from patients because of insurance protections. Lack of such information could lead to an under-reporting of alcohol-involved crashes and keeps patients from being screened properly to obtain appropriate substance use intervention services.

1. Project Purpose

A comparison of police perception of alcohol use of injured drivers admitted to the Shock Trauma Center (STC) with their actual BAC results captured upon admission was conducted. The lack of a quantifiable BAC level, especially for drivers of motor vehicles involved in a crash that resulted in a fatality, may have a deleterious effect on a State's ability to provide timely and accurate data to NHTSA's national Fatality Analysis Reporting System (FARS).

DWI arrests are made by police officers who observe a motor vehicle operator driving erratically. Officers have the opportunity perform roadside sobriety tests or a breathalyzer. Often when there is a crash, circumstances preclude any alcohol screening from taking place by police. Additionally a medical facility treating the victim will not perform a BAC test out of concern of its possible effect on reimbursement by an insurance carrier. This inability to gather quantitative evidence on a driver's BAC is likely to lead to the under-reporting of alcohol-involved crashes in a particular State or locality.

2. Methodology

Data Used

Data from 2007 and 2008 compared the police perception (from the PAR) of injured drivers admitted to the STC with their actual BAC results captured upon admission. 2,033 motor vehicle operators were admitted to the STC for which a crash report and toxicology result were both available and who were identified on the crash report as being 'apparently normal' or 'had been drinking'.

Procedure

Data from the Maryland Automated Accident Reporting System (MAARS) were linked to trauma registry data provided by the STC.

3. Results

It was calculated that when a motor vehicle operator tests positive for alcohol with a level of less than .08 mg/dl, the crash report also identified alcohol involvement in 37 percent of these cases. The sensitivity increased with increasing blood alcohol level to 54 percent for a BAC of greater than .08 mg/dl but less than .15 mg/dl and to 64 percent when the driver's BAC level was greater than .15 mg/dl.

4. Discussion

The improvement of BAC surveillance at hospitals would increase the likelihood that impaired drivers may be identified more readily. Such testing should be considered both as part of a clinical assessment and as a tool in determining the presence of a substance use disorder. Making the test results available for FARS analysts would help to accurately identify the extent of alcohol involvement in fatal crashes, thus reducing the reliance on imputation for BAC test results.

Maryland Nighttime Seat Belt Enforcement Campaign

Maryland CODES, 2011
National Study Center for Trauma and EMS, University of Maryland Baltimore

Abstract

A collaborative effort between the NSC, MHSO, and NHTSA was organized to determine if a Click It or Ticket (CIOT) enforcement model could be modified to effectively reduce the numbers of unbelted incapacitating injuries and/or fatalities during nighttime hours.

1. Project Purpose

- Identify statewide and county police-reported unbelted crash locations
- Identify reported unbelted incapacitating injury and fatal driver or occupant crash locations
- Identity trend of crash severity during the day in comparison to nighttime
- Are unbelted drivers more likely to be driving at night?
- Are unbelted drivers more likely to drive after drinking?
- Are unbelted drivers worse in terms of crash and violation history?
- Is a nighttime seat belt violation a strong predictor of other high risk behaviors?

The NSC has provided data outputs to help: document and identify the problems associated with seat belt usage at night, assist with the development of an appropriate intervention plan, and assist in developing performance measure guidelines to evaluate the effectiveness of a nighttime seat belt enforcement initiative. National findings have shown that the CIOT model could be successfully modified for use in a nighttime enforcement effort. MHSO would like to implement such a concept and track outcomes to evaluate the effectiveness of a CIOT model for the nighttime enforcement in Maryland.

2. Methodology

Data Used

2004-2008 Crash, Hospital ED, Hospital Inpatient Data

Procedure

Crash data was linked with hospital ED and inpatient data using CODES2000 software. Five years of data (2004-2008) was analyzed for drivers of passenger vehicles.

3. Results

A total of 8,589 drivers of passenger vehicles were involved in crashes from 2004 to 2008 and linked to hospital records. Approximately 13 percent of those drivers were reported to be unbelted and 23 percent were involved in crashes that occurred during nighttime hours (8 p.m. – 4 a.m.). The majority of unbelted drivers were 20 to 64, male, and involved in frontal crashes (where seat belts are most effective). Close to 40 percent of those unbelted drivers crashed during nighttime hours. Serious injuries (MAIS 3+) were more common among unbelted drivers (43.2 versus 31.5%). These figures remained constant during both daytime and nighttime hours.

- An increase in nighttime seat belt use may reduce driver deaths and injuries.

4. Discussion

NSC worked collectively with the Maryland Highway Safety Office (MHSO) to educate internal field staff (R/CTSPs) who would be assisting with implementing nighttime enforcement campaigns across the State using a CIOT model. Factsheets were prepared for each jurisdiction and used along with PowerPoint presentations to educate the grassroots groups on specific details of the campaign and areas to target. Additional presentations were given to SHA personnel to educate them on the efforts being coordinated from across the State and the research findings, validating the work being conducted.
This is a pilot project that the MHSO is coordinating along with NHTSA. The NSC will continue to support the work being conducted by the MHSO by providing them with appropriate data findings and interpretation.

CRASH OUTCOME DATA EVALUATION SYSTEM
Promising Practice Applications Using CODES Data

Using Minnesota CODES to Describe the Health Outcomes of Lane Departure Crashes

Minnesota CODES, 2011
Injury and Violence Prevention Unit, Minnesota Department of Health (MDH)

Abstract

In a joint effort with the Minnesota DOT, we analyzed factors and health outcomes of lane departure crashes, incorporating CODES linked data, presenting the results at the Minnesota annual TZD conference.

1. Project Purpose

The purpose was to analyze factors and health outcomes of lane departure crashes. The Minnesota Department of Transportation (Mn/DOT) Assistant Traffic Safety Engineer proposed this as a joint effort between Mn/DOT and MDH with the end-product being a co-presentation at the Annual Minnesota Toward Zero Deaths (TZD) Conference in October 2010.

2. Methodology

Data Used

This analysis used linked Minnesota crash and hospital data for the years 2004 – 2005. The specific data set was the MAIS/KABCO data model with missing values imputed by the CODES Technical Resource Center.

Procedure

We defined lane departure crashes as non-intersection crashes that where the crash circumstance was ran off road to the left or right, head-on or sideswipe from opposing directions, We used MAIS overall and MAIS head, as calculated by the CODES Program Resource Center using ICDMAP-90. We calculated median charges using NHTSA's macro for the maximum likelihood estimate of the median and the corresponding confidence interval. To look at factors associated with outcome, we ran logistic regressions on fatal versus nonfatal and discharge-to-home versus all other outcomes, incorporating lane departure crash as one of the explanatory variables in each model.

3. Results

For the two years combined, the CODES linked data set had 15,484 lane departure crashes (33% of all linked cases). Lane departure crashes resulted in more fatalities severe injuries and TBIs than other non-intersection crashes. Patients who had been in lane departure crashes incurred higher median hospital charges, especially in the emergency department, and were less likely to be discharged to home compared with patients in other non-intersection crashes. Lane departure crashes were not associated with fatality when adjusting for severity, restraint use, rural versus urban location and other factors.

4. Discussion

Ms. Katie Fleming from Mn/DOT and Ms. Anna Gaichas from the Minnesota Department of Health presented the results in the "How Do We Get to Zero Deaths on Minnesota Roads?" breakout session at the Annual Minnesota TZD Conference on October 25, 2010 (https://netfiles.umn.edu/cts/tzdconference/2010/3-Gaichas-Fleming.pdf). Fleming and Gaichas plan to collaborate on further analyses related to lane departure crashes and other traffic safety issues.

CRASH OUTCOME DATA EVALUATION SYSTEM
Promising Practice Applications Using CODES Data

Using CODES Data to Determine the Effectiveness of Seat Belts in Lowering Healthcare Costs and Reducing the Risk of Death in Missouri

Missouri CODES, 2011
Missouri Dept. of Health and Senior Services

Abstract

The goal of this study was to analyze Missouri's crash and injury data to determine the effectiveness of seat belts in preventing deaths and lowering healthcare costs.

1. Project Purpose

Support future attempts to pass a primary seat belt law and provide information for the upcoming revision of Missouri's Strategic Highway Safety Plan. Missouri's recent effort to pass a primary seat belt law was defeated, and it is expected that similar bills will be proposed in the future. Additionally, a committee has been formed to update Missouri's Strategic Highway Safety Plan. The committee includes CODES staff and it is likely they will be asked to provide data for the plan.

2. Methodology

Data Used

Inpatient, outpatient and mortality records linked to 2007 and 2008 Highway Patrol crash records.

Procedure

After imputing unknown values, linked data for 2007 and 2008 were analyzed using PROC LOGISTIC to estimate the odds of death for non-users of seat belts while controlling for other variables. PROC MIANALYZE was used to combine results for the five imputations. A number of additional logistic models were run to check the stability of the ORs, including the model used in the 1995 NHTSA study. Hospital-specific cost multipliers were used to estimate inpatient and outpatient costs from charges. The estimates were adjusted for inflation and compared for belted and unbelted patients by using PROC GLM to control for the same variables used in the logistic analysis. Within-and-across imputation variances were combined to develop appropriate CIs for the cost estimates.

3. Results

The OR for lack of seat belt use for the combined imputations was 19.4 with a CI of 16.4 – 23.4. The results for the other models were quite similar. The OR for the NHTSA model relating seat belt use to death was .06, not too different from the OR of approximately .09 found for Missouri in the NHTSA study. The adjusted combined inpatient-ED costs averaged $9701 (CI $8,557 - $10,844) for belted patients and $13,122 (CI $12053 - $14,191) for unbelted patients, a significant difference.

4. Discussion

An outline and charts and tables will be used in a presentation to the requestor, the TRCC and others, after discussing the results with NHTSA staff. The variables used in the model for estimating the OR were also used to compare costs. Additional models will be developed to see if a better fit to costs can be achieved, and to determine how the estimates vary depending on the models. The results of the logistic regression appear to represent effectiveness ratings (fatality reduction percentages) that are over 90 percent. They are in line with the 1995 NHTSA study (89), but much higher than the 40-50 percent range found in matched-pair comparison studies and in the December 2000 report by NHTSA (Kahane, 2000). Assuming no gross errors were made in this study, the outcome suggests that the methods used may not control confounding variables well enough to provide accurate estimates of ORs and costs.

CRASH OUTCOME DATA EVALUATION SYSTEM
Promising Practice Applications Using CODES Data

Magic Behind Nebraska's Motor Vehicle Crash Fatality Trend

Nebraska CODES, 2011
Nebraska Department of Health and Human Services

Abstract

Nebraska CODES, EMS, trauma registry data, and other related data were examined to identify factors that contributed to motor vehicle crash fatality decline in the last decade.

1. Project Purpose

To identify factors that contributed to Nebraska motor vehicle crash fatality decline in the last decade; and to support future highway safety and public health acts. Nebraska crash fatality reached a record low in 2010. We worked with Nebraska Office of Highway Safety to identity and acknowledge contributing factors to this highway safety success, as well as to use data to support highway safety and public health acts.

2. Methodology

Data Used

2001-2010 Nebraska CODES data (linked crash and hospital data were available until 2008), 2001-2010 Nebraska trauma registry data, 2005-2009 Nebraska EMS data.

Procedure

Crash fatalities and/or injuries were cross tabulated by age, gender, alcohol involvement, seat belt use, crash type, crash location, and time of crash. Hospital charges were compared by injury severity, alcohol involvement, and seat belt use. Trauma registry case-fatality rates and EMS response time were plotted over years to indicate changes in quality of health care.

3. Results

The following factors were found to have possibly contributed to crash fatality decline: increasing seat belt usage, improved trauma care, faster EMS response, and less exposure to the roads in specific time periods.

4. Discussion

This study was presented at Nebraska Highway Safety Advocate, Council of State and Territorial Epidemiologists Annual Conference, and CODES Advisory Committee Meeting. This study will be used to acknowledge EMS and trauma care providers for their contributions; and to support future legislations and highway safety campaigns.

CRASH OUTCOME DATA EVALUATION SYSTEM
Promising Practice Applications Using CODES Data

Using CODES to Promote Back Seat Usage for All Children up to 12 Years Old in New York State

New York CODES, 2011
New York State Department of Health, Bureau of Injury Prevention

Abstract

New York CODES analyzed injury outcomes for children up to12 years, comparing those riding in the front seat to those in the back seat.

1. Project Purpose

To assist the New York Child Injury Prevention Policy Subgroup in their initiative to reduce childhood motor vehicle injuries by promoting back seat use. The recommended best practice for children up to12 years is to ride in the back seat when in a motor vehicle. New York laws require children up to 7 years old to be restrained in the appropriate child restraint system and children 8 to 15 years old to use seat belts. These laws do not specify a seating position. The New York Child Injury Prevention Policy Subgroup requested data comparing injury outcomes from children by seating position.

2. Methodology

Data Used

This analysis used linked New York crash and hospital data for the years 2006-2008.

Procedure

Analysis was done on motor vehicle passengers 12 and younger involved in a motor vehicle crash by seating position using police and motorist crash reports linked to health outcome data (hospitalization and emergency department). Restraint use and other explanatory variables of interest were considered. Multivariate logistic regression was used to adjust for potential confounders.

3. Results

For ages up to 12 years old, 11.6 percent of the children involved in crashes and riding in the front seats were injured compared to 7.6 percent of those riding in the back. The resulting odds ratio of 1.6 (95% C.I. 1.5, 1.7) demonstrates riding in the front seat significantly increases the odds of being injured. The adjusted odds ratio of 1.1 (95% C.I. 1.1, 1.2) still demonstrated a statistically significant protective factor for riding in the back seat. For ages up to 7 and using a child restraint, front seat passengers had a higher injury rate (7.4% versus 5.9%). This also holds true for children up to 7-year-olds using only seat belts (10.9% versus 7.4%) and those not restrained at all (15.8% versus 12.8%). Similar results are seen for 8- to 12-year-olds where belted front seat passengers had a higher injury rate (12.1% versus 9.8%), as did those unbelted (25.2% versus 20.1%). Riding in the front seat also results in higher percent of traumatic brain injuries and higher median hospital charges.

4. Discussion

Results from this study were provided to the New York Child Policy Injury Prevention Policy Subgroup and presented at the 37th International Forum on Traffic Records and Highway Safety Information Systems. This study demonstrates that back seat requirements would enhance the child passenger safety laws.

Injuries Among Older Adults in Ohio, 2004 - 2009

Ohio CODES, 2011
Center for Injury Research and Policy, The Research Institute at Nationwide Children's Hospital

Abstract

The goal of this study was to describe key factors associated with injuries among adults 70 or older in Ohio, with particular emphasis on motor vehicle crashes, pedestrian collisions, falls, residential fires, and self-inflicted injuries.

1. Project Purpose

Describe medical and economic impact of injuries among adults 70 or older in Ohio. Injuries among older adults are a special interest for the Ohio Department of Public Safety. The intent of this study was to educate the public and safety decision makers about key factors associated with the medical and economic outcome of injuries among older adults in Ohio, with particular emphasis on common mechanisms of injury such as motor vehicle crashes, pedestrian collisions, falls, residential fires, and self-inflicted injuries.

2. Methodology

Data Used

This analysis used five independent data sets (Ohio crash records, EMS records, hospital records, trauma registry records, and death records), as well as two probabilistic linkages (Ohio crash records linked with Ohio hospital records, and Ohio hospital records linked with Ohio trauma registry) for the data years 2004 to 2009.

Procedure

Descriptive information was compiled for all injured Ohioans 70 years or older included in the five individual data sets, as well as for those injured older adults in the Hospital records that linked to the Crash database. Injured older adults and injured individuals in other age groups were compared on factors related to the crash occurrence and outcomes, including LOS, inflation-adjusted hospital charges, and survival. In addition, older adults injured in motor vehicle crashes and pedestrian collisions were compared to older adults injured as a result of other mechanisms, including falls, residential fires, and self-inflicted injuries.

3. Results

During 2004 to 2009, there were an annual average of 45,355 EMS runs, 110,626 ED visits, 55,164 inpatient hospitalizations, 9,700 severe trauma admissions, and 1,619 deaths due to injury among Ohioans 70 or older. Annually, injured older adults accrued $1.6 billion in hospital charges and spent 322,962 days in the hospital. Mean hospital charge among older adults was $28,875 and mean length of stay was 5.9 days. Motor vehicle crashes were the third leading cause of injury death among adults 70 or older. An annual average of 37,827 older adults were involved in motor vehicle crashes. Of these, 7,050 (18.6%) sustained a police-reported injury. Only 1.2 percent of older adults were impaired by alcohol, compared to 8.1 percent of adults 18 to 69 years old. Eighty-four percent of crashes among older adults occurred during daylight hours (6 a.m.-6 p.m.), compared to 66.7 percent of crashes in adults 18 to 69 years old.

4. Discussion

A formal report and brief brochure with tables, graphs, and an outline of key findings will be disseminated to the Ohio Department of Public Safety and other stakeholders in Ohio and nationally upon completion of this project. The report and summary will also be posted on the Center for Injury Research and Policy Web site at
www.publicsafety.ohio.gov/links/Injury%20Among%20Older%20Adults%20in%20Ohio%20-%20Final%20Project%20Report.pdf.
The broader impact of this project is yet to be determined. The Ohio CODES team selects topics of interest for the entire traffic safety community, with a targeted focus directed towards legislators and policymakers.

CRASH OUTCOME DATA EVALUATION SYSTEM
Promising Practice Applications Using CODES Data

Using CODES Data to Supplement the South Carolina Traffic Collision Fact Book

South Carolina CODES, 2011
South Carolina Budget and Control Board, Office of Research and Statistics

Abstract

Starting with the 2010 CODES data, the South Carolina Department of Public Safety plans to supplement the annual South Carolina Traffic Collision Fact Book crash statistics with health outcome statistics derived from the CODES data.

1. Project Purpose

Identify traffic safety problems, support decision makers, and educate the public. The South Carolina Department of Public Safety requested the ORS run statistics (level of care, length of stay, charges/costs) on the CODES data to supplement the crash statistics within the Traffic Collision Fact Book.

2. Methodology

Data Used

Multiply imputed CODES GUM data relevant to the year of the Fact Book publication. The 2005 General Use Model (GUM) data is being used to develop the code for data tables, charts, and as a proxy for current data. Upon receipt and linkage of current data, the project will be updated.

Procedure

This project includes all persons involved in crashes during a calendar year in South Carolina in which the Fact Book will be published (2010 data will be used in the publication of the 2010 Fact Book). The probabilistically linked crash, emergency department and inpatient data has been multiply imputed and summarized to create tables that will mimic those in the Fact Book; however the CODES tables will show charges, costs relative to the table descriptors.

3. Results

CODES statistics to be published in the Fact Book will include health outcomes with regard to level of care, length of stay, charges/costs. At this time, those statistics mimic the “Victim Profiles,” “Injury Severity by Occupant Restraint Use,” and “Injuries by Seating Location” tables found in “Part III – Collision Consequences” of the Fact Book.

4. Discussion

Tables, graphs, and text published in the Traffic Collision Fact Book, hard copy available to internal DPS staff only, and via the SC DPS, Office of Highway Safety Web site at www.scdps.org/ohs/stat_services.asp.
The GUM does not include certain variables of interest to South Carolina; those variables must be defined and included in the GUM data set. Several more tables and charts are planned.

CRASH OUTCOME DATA EVALUATION SYSTEM
Promising Practice Applications Using CODES Data

Driver Seat Belt Use Indicates Decreased Risk for Child Passengers in Motor Vehicle Crashes in Utah

Utah CODES, 2011
University of Utah, Intermountain Injury Control Center

Abstract

Utah CODES published a manuscript in Accident Analysis and Prevention that showed an association between driver characteristics, including seat belt use, and child motor vehicle crash-related medical outcomes. This suggests that interventions targeted at drivers, including primary seat belt legislation, have potential to improve medical outcomes of child passengers.

1. Project Purpose

As a part of Utah CODES continuing efforts to support primary seat belt legislation, we undertook this analysis along with Pediatric Critical Care collaborators at the University of Utah School of Medicine to study the effect of driver seat belt non-use on medical outcomes of children. The manuscript was targeted at traffic safety and injury researchers, and was distributed to Utah traffic safety advocates. The analysis was also presented to safety advocates and child passenger safety technicians as a part of a Safety Summit sponsored by the Utah Highway Safety Office.

2. Methodology

Data Used

This analysis used linked Utah crash and hospital data for the years 1999 to 2004.

Procedure

This cohort study included child passengers up to12 years old riding with adult drivers 21 or older involved in motor vehicle crashes in Utah from 1999 to 2004. The six years of Utah MVC records were probabilistically linked to statewide Utah emergency department records. We estimated the relative risk of ED evaluation following a MVC for children riding with restrained versus unrestrained drivers. Generalized estimating equations were used to calculate relative risks adjusted for child, driver, and crash characteristics.

3. Results

Six percent of children riding with restrained adult drivers were evaluated in the ED compared 22 percent of children riding with unrestrained adult drivers following MVCs (relative risk 0.29, 95% confidence interval 0.26–0.32). After adjusting for child, vehicle, and crash characteristics, the relative risk of child ED evaluation associated with driver restraint remained significant (relative risk 0.82, 95% confidence interval 0.72–0.94). Driver restraint use was associated with child restraint use, less alcohol/drug involvement, and lower relative risk of severe collision types (head-on, rollover).

4. Discussion

Manuscript was published in Accident Analysis and Prevention (PubMed link: www.ncbi.nlm.nih.gov/pubmed/20159106)
This paper received a lot of attention in Utah. We were asked by the Utah Highway Safety Office to present these findings in their Child Passenger Safety track of their Zero Fatalities Safety Summit, which was attended by child passenger safety technicians, police and highway patrol officers, traffic safety experts and other child and traffic safety advocates. We will continue to use our findings to support a primary seat belt law in Utah.

CRASH OUTCOME DATA EVALUATION SYSTEM
Promising Practice Applications Using CODES Data

Using CODES Data to Analyze Motorcycle Crash Outcomes in Virginia

Virginia CODES, 2011
Virginia Health Information

Abstract

Virginia CODES worked with the Virginia Highway Safety Office to analyze outcomes of motorcycle crashes.

1. Project Purpose

To identify factors associated with increased M/C crashes, fatalities and injuries in order to assist in the formulation of action plans to reduce them. Motorcycle crashes increased from 1,743 to 2,601 (49%), fatalities increased from 44 to 126 (186%) and injuries climbed from 1,506 to 2,284 (52%).

2. Methodology

Data Used

This analysis used linked 2001-2007 Virginia crash, hospital, traffic conviction and 2007 motorcycle student training data.

Procedure

Virginia motorcyclists involved in crashes, traffic conviction and CODES motorcycle data and 2007 motorcycle student training data were linked for each of 14,855 motorcyclists involved in crashes between 2001 and 2007.

3. Results

Between 2001 and 2007, there were 14,855 motorcyclists involved in crashes resulting in an estimated 2,787 patients admitted to Virginia hospitals. This resulted in a total of 13,638 patient days at a cost of over $122 million. The cost increased over the years: 360 percent increase from 2001 versus 2007 ($7.5 million versus $27 million). Motorcycle riders 15 to 55 with at least one motor vehicle conviction 5 years prior to the crash tend to be involved with higher risk taking actions compared to the non-conviction group. Actions include: eluding police and failing to maintain proper control. An analysis of motorcyclists in crashes and students who attended motorcycle training courses was also conducted. The findings show that (1) novice motorcyclists caused most of the crashes; (2) two-thirds of the crashes involved sport-bike riding motorcyclists; (3) most motorcycle crashes were single-vehicle crashes; and (4) $28,410 and 1 day in the hospital were the average hospital costs/stay for trained motorcyclists involved in crashes.

4. Discussion

Information can be included in materials to train motorcycle students in Virginia, news releases by the Virginia DMV Communications Office and statewide conferences. Also, information can be used by management to improve safety on Virginia's roadways.

2012 Promising Practice Applications Using CODES Data

CRASH OUTCOME DATA EVALUATION SYSTEM
Promising Practice Applications Using CODES Data

Characteristics and Outcomes of Connecticut Pedestrian and Pedal Cyclist Crashes

Connecticut CODES, 2012
Connecticut Department of Public Health

Abstract

The Connecticut CODES Project examined the characteristics and outcomes of crashes that involved pedestrians and pedal cyclists. Results will be incorporated into educational materials and awareness messages and to guide resource allocation for pedestrian and cyclist safety and advocate for the resources to construct walking paths and bike lanes.

1. Project Purpose

Characteristics and outcomes of crashes involving pedestrians and pedal cyclists. There have been ongoing arguments about whether it is fiscally responsible or even beneficial to increase the number of walking paths and bike lanes in Connecticut when there is a budget crisis. Between 2005 and 2008, there were more than 4,300 pedestrians and 2,400 cyclists involved in crashes; 172 were killed. Most of these crashes occurred during daylight hours when the weather was not inclement. It is important to increase awareness among drivers, pedestrians, and cyclists about road safety, but access to safe walking and cycling areas is the best way to reduce serious injury and death among pedestrians and cyclists, and it will also help increase physical activity among residents.

2. Methodology

Data Used

Connecticut's CODES General Use Model datasets for the years 2005 to 2008 were used.

Procedure

The analysis looked into characteristics and factors associated with pedestrian and cyclist crashes including ED discharge status; road and weather conditions; pedestrian and cyclist age and gender; lighting conditions; safety equipment used by cyclists; highest level of care; and injury severity.

3. Results

The majority of pedestrians and cyclists (60%) injured in crashes were male, and 65 percent who were killed were male. One-half of pedestrians and cyclists killed were 50 or older. For pedestrian crashes, 152 were fatal for the pedestrian, and the number of fatalities increased with age. For cyclists, 20 were killed; all were male. Additionally, 75 percent of cyclists who were killed were not wearing helmets. One-half of crashes when a pedestrian was killed occurred when it was dark but lighted; for fatal cyclist crashes, 70 percent occurred in daylight. While fatality and injury rates decreased between 2005 and 2008 for drivers and passengers, the rates for pedestrians and pedal cyclists increased or were unchanged.

4. Discussion

Results will be shared with CODES Advisory Board members, Connecticut Department of Transportation, Capitol Region Council of Governments, and the general public through fact sheets and presentations.

CRASH OUTCOME DATA EVALUATION SYSTEM
Promising Practice Applications Using CODES Data

Injury Analysis of Delaware Teen Driving Crashes

Delaware CODES, 2012
Office of Emergency Medical Services, Division of Public Health, Delaware Health and Social Services

Abstract

Motor vehicle crashes are the leading cause of death among teens. Using CODES data to analyze the hospital charges/costs in teen driving crashes we produced a fact sheet that was distributed to Delaware Driver Education Assessment. The fact sheet information contributes to the efforts in preventing injuries, saving lives, and reducing economic costs of motor vehicle crashes on Delaware's roadways.

1. Project Purpose

This project provided the information of differences on hospitalized occupants involved in teen driving as requested by Delaware Office of Highway Safety. The audiences included Highway Safety, EMSC, and Injury Prevention Programs.

2. Methodology

Data Used

Delaware linked imputed crash and hospital data for the years 2003 to 2008 were used in this application.

Procedure

Descriptive statistics were used to compare the crash and injury outcomes for hospitalized occupants involved in teen driving crashes.

3. Results

- The estimated average medical cost for 16- and 17-year-old drivers was higher than other age groups drivers involving in MVC.
- The estimated average medical cost for 16- and 17-year-old drivers for driving from 8 p.m. to 12 a.m. was higher than other age groups drivers involving in MVC.
- The top three costly body part injuries for 16- and 17-year-old drivers were abdominal, head, and thorax.

4. Discussion

- The result of the study was a PowerPoint presentation at CODES board meeting.
- Participated in the panel of Delaware Driver Education Assessment.

Using Georgia CODES Data to Develop a System Dynamics Model on Motor Vehicle Safety

Georgia CODES, 2012
Georgia Department of Public Health, Office of Injury Prevention

Abstract

Georgia CODES collaborated with Georgia Health Policy Center to develop a System Dynamics Model on Injury Prevention focusing on Motor Vehicle. This model uses CODES linked crash and hospital data within this project. GSU modeling project is an experiential learning tool to understand and communicate the systemic issues behind traumatic injuries in Georgia in order to determine and promote effective prevention strategies for dramatic reduction.

1. Project Purpose

The model will be used as a learning tool for legislators, advocacy groups and service providers for decision-making and priority setting. Georgia will have a tool to improve public and legislative understanding about trauma prevention and increase support for systemic programs and policies.

2. Methodology

Data Used

This analysis uses linked Georgia crash and hospital data for 2005 and 2008.

Procedure

A break out of linked data and all crashes, with road type, urban/rural, contributing factors and manner of collision. Hospital charges, sex, and age was also stratified by TBI and burns.

3. Results

Speed, disregard signal, failed to yield, improper lane change and possible impairment were used for the model by manner of collision. Failed to yield contributed to 54 percent of the hospitalized angle crashes and 29 percent of the head on crashes.

4. Discussion

Tables were provided to the modeler and the model was demonstrated among the stakeholders. This model will be used during the Georgia Health Policy Center's Legislative Health Policy Certificate Program. This model will also be presented to the Traffic Records Coordinating Committee. This is the first version of the model. The next version will also include restraint use and other types of injuries.

CRASH OUTCOME DATA EVALUATION SYSTEM
Promising Practice Applications Using CODES Data

Motorcycle-Related Crash Victims and Their Associates Hospital Charges in Illinois

Illinois CODES, 2012
Illinois Department of Transportation, Division of Traffic Safety (DTS)

Abstract

Using the 2009 linked crash and hospital inpatient and emergency departments data, this report intends to provide data and information on cost and medical outcomes of motorcyclists who were injured in motor vehicle crashes and hospitalized in Illinois hospitals.

1. Project Purpose

The study population was all motorcyclists who were injured in motor vehicle-related crashes and hospitalized in 2009 in Illinois. Data and information included in this study were hospital charges and the health consequences of crash victims. The project was initiated by Motorcycle Safety Unit at DTS. Results of the linked crash/hospital discharge and ED data were presented to the ITRCC, HSP committee and Motorcycle Safety Group.

2. Methodology

Data Used

Illinois linked 2009 crash data to 2009 hospital inpatient and ED data.

Procedure

CODES2000 was used to create five separate multiply imputed data sets of linked records. The imputed linkage results served as the input data set to IVEware to create multiple imputations replacing missing values with estimated values.

3. Results

Based on the linked data, a total 3,539 motorcyclists were identified to be involved in crashes. Of the total, 1,818 motor cyclists involved in crashes were linked to the hospital discharge and ED data (466 for inpatient versus 1,352 for ED). As expected, the majority of the crash victims (42.4%) didn't wear helmet. About 36 percent of non-helmeted motorcyclists had head injuries versus only 10.7 percent of helmeted motorcyclists. The average charge per discharge for both inpatient and ED discharge was $22,555. Results and policy implications are discussed.

4. Discussion

Results have been presented to: CODES Advisory Committee; Illinois TRCC; IDPH Data Committee; HSP Committee, and motorcycle safety group at the Illinois Department of Transportation (IDOT).
We are planning to replicate this study using the linked 2010 crash/hospital inpatient and ED data when we complete the linkages sometime this year. Since the CODES project is resided at DTS where the highways safety programs are, the highway safety professionals are very interested in financial and medical outcome of the crash injuries.

CRASH OUTCOME DATA EVALUATION SYSTEM
Promising Practice Applications Using CODES Data

Differences in Protective Effect of Motorcycle Helmets by Nature of Traumatic Brain Injury in Kentucky.

Kentucky CODES, 2012
Kentucky Injury Prevention and Research Center, University of Kentucky College of Public Health

Abstract

This study uses CODES data to show that motorcycle helmets offer substantial protection against skull fracture and intracranial injury, and moderate protection against concussion.

1. Project Purpose

Inform decision makers and the general public about the protective benefits of motorcycle helmets against specific types of traumatic brain injury. Kentucky's universal motorcycle helmet law was repealed 1998. Despite a considerable body of evidence demonstrating their protective effects against brain injury, claims about the efficacy of MC helmets are still challenged by some. The purpose of this study was to clarify the types of TBI against which MC helmets offer the greatest protection, using Kentucky-specific data.

2. Methodology

Data Used

We used linked crash, inpatient, and emergency department data for 2008, 2009 and 2010.

Procedure

We will use a retrospective cohort design. Crash-involved motorcycle riders will be identified through the CODES files for 2008 to 2010. Riders will be classified into two groups based on their police-reported helmet use. Four TBI outcome variables (any TBI, skull fracture, intracranial injury, and concussion) will be created based on ICD-9-CM diagnostic codes on the hospital files. Adjusted relative risks (RR) of each outcome for non-helmeted versus helmeted riders will be estimated via Poisson regression. Age, gender, speed, manner of collision, impairment, and other factors identified through literature review will be considered as possible confounders and effect modifiers.

3. Results

- Helmets provide protection against skull fracture, intracranial injury, and concussion
- The protection against "Type I SF," is significantly greater than the protection against the other types of TBI
- The protection against Type II concussion is significantly less than the protection against both Type I SF and Type I ICI
- Some concern about (non-) coding of concussion, particularly when a Type I SF or Type I ICI is present.
- Also need to think about the effect (i.e. bias) on the RR estimates of not including those MC operators who died at the scene nor those who were uninjured or never reported by police.

4. Discussion

Findings will be summarized in a policy brief for dissemination to local policy-makers and submitted to an appropriate journal for publication.

CRASH OUTCOME DATA EVALUATION SYSTEM
Promising Practice Applications Using CODES Data

Experience Counts – Maryland Crash and Citation Rates for Newly Licensed Drivers Regardless of Age

Maryland CODES, 2012
National Study Center for Trauma and EMS, University of Maryland School of Medicine

Abstract

Graduated driver licensing systems are developed based on age, typically affecting drivers under 18 seeking an initial license. However, older drivers are not required to fulfill GDL requirements when first applying for a license, but have the same lack of driving experience as a 16-year-old. To better understand the effects of age and experience on driving outcomes, crash involvement and citation issuance rates were calculated for newly licensed drivers and a comparison group that were transferring or renewing a license in Maryland. Those rates were calculated for two age groups, 18 to 24 and 25 and older, to determine if GDL policies should be implemented for all new drivers regardless of age.

1. Project Purpose

Support efforts to prevent a reduction in licensing requirements by the legislature for persons over 21. The Maryland Motor Vehicle Administration requested this analysis to support efforts to prevent the legislature from reducing the number of training and on-road hours needed prior to obtaining a driver's license for those over 21 years old in Maryland.

2. Methodology

Data Used

Crash – Maryland Automated Accident Reporting System (MAARS)
Citation – Maryland District Court
Driver Licensing – Maryland Motor Vehicle Administration.

Procedure

Drivers were identified in the 2009 MVA file as newly licensed or renewed/transferred (using date/type of license issuance). Those two groups were linked to crash reports and citation files from 2010-2011 (using driver license number) to quantify outcomes. Crash and citation rates per licensed drivers were calculated and compared.

3. Results

- Among younger drivers (18 to 24), crash and citation rates per 100 licensed drivers were higher among the newly licensed as compared to the renewals/transfers (crashes – 10.1 v 6.1; citations – 28.0 versus 22.2).
- Among older drivers (25+), crash and citation rates per 100 licensed drivers were also higher among the newly licensed as compared to the renewals/transfers (crashes – 6.9 v 3.8; citations – 15.8 versus 10.8).
- Overall, the younger drivers had higher crash and citation rates as compared to the older drivers, but a trend towards inexperience can be seen by the significant differences shown in both age groups. Therefore, both age and lack of driving experience should be considered when identifying target populations.

4. Discussion

Findings were supplied to requesting agency (MVA) in the form of tables and talking points, and will be presented at the 2012 Lifesavers Conference and 2012 Traffic Records Forum.

CRASH OUTCOME DATA EVALUATION SYSTEM
Promising Practice Applications Using CODES Data

Is It Boomers and Their Harleys? Motorcycle Crash in Minnesota

Minnesota CODES, 2012
Minnesota Department of Health

Abstract

After describing the increasing trend in motorcycle rider fatalities and injuries in recent years, we used CODES linked data to identify associated modifiable and non-modifiable risk factors.

1. Project Purpose

This analysis grew out of concerns by the Motorcycle Safety Coordinator at the Minnesota Department of Public Safety. It had been noted that the highest rates of motorcycle mortality by age corresponded with the aging of the "boomers." There were questions about other outcomes, including hospitalization and charges. The targeted audience is motorcycle safety researchers and advocates.

2. Methodology

Data Used

For this investigation, the 2004-2005 CODES imputed linked data for traffic crashes involving motorcycles were examined, as well as hospital data going back to 1998, the traumatic brain and spinal cord injury registry going back to 1993, death certificate data going back to 1990 and license/permit data from 2001-2010.

Procedure

Trends of motorcycle crash and injury rates, including rates of traumatic brain injury, per licensed operators were examined. Using CODES data, logistic regression models were run on fatal versus nonfatal, injured versus non-injured and TBI versus other injury to determine factors associated with these outcomes. Factors examined included age, gender, helmet use, speeding, impairment and location. The relationship between the type and manufacturer of motorcycles and factors such as age, speed, and injury severity were also examined.

3. Results

The results indicate an increasing trend in motorcycle rider mortality, morbidity, and disability. "Baby boomer" age groups and speeding were associated with fatality, injury and TBI, adjusting for other factors. In addition, not wearing a helmet and impairment were associated with TBI; male gender and rural location were associated with injury; and impairment and rural location were associated with fatality. Thirty percent of fatalities and 19 percent of injuries occurred to riders of Harley Davidson vehicles.

4. Discussion

Results were disseminated at four conferences, tailored to the specific audiences.

- Joint Annual Meeting of the Safe States Alliance and CDC Core I & II State Injury Grantees
- University of Minnesota Center for Transportation Studies Annual Transportation Research Conference
- Council of State and Territorial Epidemiologists Annual Conference
- Annual Meeting of the Society for Epidemiologic Research

The 2006-2007 CODES data are being integrated into this analysis. Additional planned analyses include examining hospital charges and payer source. These findings could help support continued efforts by partners (including the Minnesota Brain Injury Alliance) to pass a bill requiring individual Minnesota motorcyclists to pay more insurance if they want the option of not wearing helmets when riding their own cycle.

This application uses the classic and time-tested public health strategy of providing technical expertise to, and working with, partners to effect public policy development.

CRASH OUTCOME DATA EVALUATION SYSTEM
Promising Practice Applications Using CODES Data

Costs Saved and Fatalities and Injuries Prevented by Use of Seat Belts in Missouri

Missouri CODES, 2012
Missouri Department of Health and Senior Services, Bureau of Health Informatics

Abstract

Hospital, E/D and mortality data for 2007-2008 were linked to Highway Patrol crash records. Analyses yielded estimates of cost savings and the number of injuries and fatalities prevented through the use of seat belts by drivers of cars and light trucks(SUVs, station wagons vans and pickup trucks).

1. Project Purpose

To support efforts to pass a primary seat belt law. The director of the Highway Safety Division of the Missouri Department of Transportation requested information showing that seat belts saved money and prevented injuries and deaths.

2. Methodology

Data Used

2007-2008 CODES data—linked crash, hospital, E/D and mortality records.

Procedure

Hospital, ED and mortality data for 2007-2008 were linked to Highway Patrol crash records, producing five imputed data files/year. Unknown values for key variables were imputed and cost/charge ratios were obtained to convert hospital and E/D charges to cost estimates. Estimates reported in the literature of effectiveness by vehicle type, seat position were used to estimate cost savings and the number of injuries and fatalities prevented through the use of seat belts by drivers of cars and light trucks.

3. Results

Effectiveness of seat belts in preventing deaths for drivers of cars and light trucks combined was estimated to be .47, with 191 drivers saved by use of seat belts. An additional 164 Deaths could have been prevented if all drivers had been belted. Effectiveness in preventing moderate-severe injuries was .57. A total of 5,084 moderate-severe injuries were prevented, and 801 additional injuries could have been prevented if all drivers had been belted. $58.8 million in combined hospital and ED costs were saved, and an additional $18 million could have been saved if all drivers had been belted.

4. Discussion

We will use charts and graphs to discuss results in meetings. The study will be updated using 2010 and 2011 data for possible presentation to the legislature. Past efforts to pass a primary seat belt law have failed. This is a preliminary study in the sense that relatively old data were used to develop the method and the computer programs.

CRASH OUTCOME DATA EVALUATION SYSTEM
Promising Practice Applications Using CODES Data

To Wear or Not to Wear Seat Belts: A Comparison of Crash Outcomes of Restrained and Non-Restrained Occupants in Nebraska

Nebraska CODES, 2012
Nebraska Department of Health and Human Services

Abstract

We used 5 years of Nebraska CODES data to compare crash outcomes of restrained and non-restrained occupants, and to provide evidence support for primary enforcement of seat belt law.

1. Project Purpose

To advocate primary enforcement of seat belt law. This study was requested and sponsored by Nebraska Office of Highway Safety, Nebraska Injury Community Planning Group (ICPG), and Nebraska State Epidemiologist.

2. Methodology

Data Used

Linked 2006-2010 Nebraska crash data, hospital discharge data, and death data.

Procedure

We compared hospital charges and fatality rate for restrained and non-restrained occupants who were involved in motor vehicle crashes in Nebraska. We described characteristics of unrestrained occupants who died in motor vehicle crashes in Nebraska during the study period. We also estimated possible increase in seat belt use and economic savings from the primary seat belt law based on literature review.

3. Results

From 2006 to 2010, seat belt use rate among occupants who were involved in motor vehicle crashes was about 80 percent, while only 30 percent of the occupants who died from crashes worn seat belt. Unrestrained occupants were almost 20 times as likely to die from crashes as restrained occupants, 5 times as likely to be admitted into hospital, and 2.5 times as likely to be treated at emergency departments. Hospital charges for unrestrained occupants were twice as high as restrained occupants. Total direct hospital charges due to motor vehicle crashes was over $100 million annually, over a quarter of which was paid by public insurance. By simply buckling up, over 300 lives and thousands of incapacitating injuries could have been saved during the 5-year study period.

4. Discussion

Fact sheets were published at Nebraska CODES Web site and Nebraska Injury Prevention and Control program Web site. Presentations were given at a CODES advisory committee meeting and Nebraska ICPG meeting.
http://dhhs.ne.gov/publichealth/Documents/restraint_use_and_crash_outcomes_in_nebraska.pdf
http://library.constantcontact.com/download/get/file/1104839107405-33/DHHS+Restraint+Use+Fact+Sheet+Final.pdf

Nebraska State Epidemiologist is planning to present this study to Nebraska legislators. The motor vehicle policy group of Nebraska ICPG is also planning to use this study to advocate primary enforcement of seat belt law.

Using CODES Data to Support an Innovative Approach to Teen Driver Safety in New York

New York CODES, 2012
New York State Department of Health, Bureau of Occupational Health and Injury Prevention

Abstract

The New York State Department of Health used CODES data to support the efforts of the New York Partnership for Teen Driver Safety in exploring the teen-driver issues in New York State.

1. Project Purpose

To explore the data-driven issues impacting teen drivers. The New York Partnership for Teen Driver Safety (NYPTDS) asked us to highlight the crash-factors and societal impact related to younger drivers in New York State.

2. Methodology

Data Used

This analysis used linked NYS crash and hospitalization/emergency department data.

Procedure

CODES data was used in this descriptive examination of the younger driver crashes. Factors examined included the ages of drivers and passengers, gender, contributing factors, time of crash, level of care and diagnosis of traumatic brain injury.

3. Results

Following the implementation of NYS graduated license law in the fall of 2003, the rates of hospitalizations and deaths have steadily decreased 54 percent and 69 percent, respectively. However, in 2009, there were still 4,994 16- to 17-year-old drivers and their passenger that were treated at a hospital due to at fault vehicle crashes. Almost 500 of these New Yorkers were diagnosed with a traumatic brain injury. The NYPTDS is working to address these problems by facilitating a collaboration of traffic safety and public health professionals to develop evidence-based and innovative strategy that will further decrease the rates of crashes, injuries and deaths among young drivers.

4. Discussion

Presentations, tables, graphs, and talking points were disseminated to members of the NYPTDS.
www.health.ny.gov/prevention/injury_prevention/teens.htm
We are planning on continuing to work with the NYPTDS. The CODES project is in a unique position to assist the NYPTDS, because TBIs are often used to frame the message around seat belt use and speeding. The NYPTDS uses the CODES data in educational messages, determining high risk counties, and creating fact sheets.

CRASH OUTCOME DATA EVALUATION SYSTEM
Promising Practice Applications Using CODES Data

Factors Affecting Motor Vehicle Crashes in Ohio, 2004-2009

Ohio CODES, 2012
Center for Injury Research and Policy (CIRP), The Research Institute at Nationwide Children's Hospital

Abstract

Probabilistically linked Ohio crash and hospital data for 2004-2009 were analyzed in order to describe the medical and economic impact of factors associated with distracting driving, aggressive driving, and impaired driving on MVC-related injuries to Ohioans.

1. Project Purpose

Describe medical and economic impact of factors associated with distracted driving, aggressive driving, and impaired driving that affect MVC-related injuries to Ohioans. Distracted driving, aggressive driving, and impaired driving have been identified as important contributors to MVCs nationally; however the extent of the influence of these behaviors on MVC-related injuries and outcomes in Ohio is not well understood. A study examining the influence of these driving behaviors was requested by the Ohio Department of Public Safety.

2. Methodology

Data Used

This analysis used probabilistically linked Ohio crash and hospital data for the years 2004 to 2009.

Procedure

The Ohio crash report was used to classify crashes related to distracted driving (driver inattention), aggressive driving (operating vehicle in erratic/reckless/careless/negligent/ aggressive manner, exceeded speed limit, unsafe speed, followed too closely), or impaired driving (fatigue/asleep, depressed or angry emotional state, illness, under the influence of medications/alcohol/drugs, alcohol/drugs suspected). Occupants were analyzed by crash and hospital care characteristics, including hospital charges and length of stay. Regression analyses were conducted to determine the influence of risk/protective factors on health and economic outcomes.

3. Results

From 2004-2009, there were 1,018,910 motor vehicle occupants involved in crashes due to distracted driving, aggressive driving, or impaired driving, and 17.7 percent of these occupants experienced injuries. The rate of crash incidents related to one of the three behavioral factors was highest among younger drivers (4,263 per 100,000 licensed drivers 16 to 19 and 3,572 per 100,000 licensed drivers 20 to 24 years old). Among fatal crashes due to distracted, aggressive or impaired driving, drivers were overwhelmingly male (79.5%), and 29.1 percent were 20 to 29 years old. Distracted, aggressive, or impaired driving-related injuries requiring inpatient hospitalization accounted for more than $484 million in hospital charges and 52,470 days of hospitalization. Mean charge was $46,171 and mean length of stay was 5.0 days.

4. Discussion

A formal report and brief brochure with tables, graphs, and an outline of key findings will be disseminated to the Ohio Department of Public Safety and other stakeholders in Ohio and nationally upon completion of this project. The report and summary will also be posted on the Center for Injury Research and Policy Web site.
www.publicsafety.ohio.gov/links/Factors%20Affecting%20Motor%20Vehicle%20Crashes%20in%20Ohio%20-%20Final%20Project%20Report.pdf
The broader impact of this project is yet to be determined. The Ohio CODES team selects topics of interest for the entire traffic safety community, with a targeted focus directed towards policymakers.

CRASH OUTCOME DATA EVALUATION SYSTEM
Promising Practice Applications Using CODES Data

Evaluating the Characteristics and Outcomes of Crashes Involving Teen Drivers in South Carolina

South Carolina CODES, 2012
SC Budget and Control Board, Division of Research and Statistics, Columbia, SC and the
Centers for Disease Control and Prevention, Atlanta, GA

Abstract

As part of the CDC exploration of CODES with NHTSA, South Carolina CODES data were analyzed in collaboration with the CDC to evaluate the differences in crash characteristics and hospital/emergency department outcomes stratified by age (teen drivers versus older drivers).

1. Project Purpose

Identify the characteristics (traffic safety problems) beyond the primary contributing factor as to why teens are involved in crashes at a higher rate than older drivers. Motor vehicle crashes continue to be the leading killer of young people in South Carolina. In 2009, a teen driver was involved in a fatal or injury crash every 1.3 hours. The results of this study will be shared with the SC Department of Public Safety to be distributed as they deem necessary.

2. Methodology

Data Used

Multiply imputed CODES General Use Model (GUM) data for years 2005 to 2008 in South Carolina.

Procedure

Describe teenage driver (15 to 17 years old) motor vehicle crashes in South Carolina for 2005-2008 and compare these crashes to those for older age groups (18-20, 21-24, 35-44) to determine if they differ; conduct a regression analysis to determine what factors are associated with teen driver motor vehicle crashes. Evaluate outcomes based on care, injury severity, and charges.

3. Results

Some highlights of teen driver involvement using injury data were:

- 16 percent of all involved persons were treated in a hospital setting.
- 25 percent of injuries sustained were rated Moderate or higher on the Maximum Abbreviated Injury Scale.
- Sprains/strains of the vertebral column were the primary (30%) injury sustained.
- Total ED charges: $32 million.
- Total inpatient charges: $40.5 million.

Using 'at fault' as reported on the SC TR-310 crash report, teen drivers "at fault":

- 15 percent of all involved persons were treated in a hospital setting.
- 15 percent of injuries sustained were rated Moderate or higher on the Maximum Abbreviated Injury Scale.
- Sprains/strains of the vertebral column were the primary (30%) injury sustained.
- Total ED charges: $23 million.
- Total inpatient charges: $32 million.

4. Discussion

Fact sheets, a report, and a journal publication are possible future products of the collaboration. The South Carolina Department of Public Safety will have the opportunity to include the findings in the South Carolina Traffic Collision Fact Book.
Driving training data are also available but the extent to which they are usable is being determined.

CRASH OUTCOME DATA EVALUATION SYSTEM
Promising Practice Applications Using CODES Data

Using Utah CODES Data to Identify Work-Related Motor Vehicle Crashes

Utah CODES, 2012
University of Utah, Intermountain Injury Control Research Center)

Abstract

We demonstrate the utility of linked motor vehicle crash (MVC) and hospital databases to provide a more complete picture of work-related MVCs. The linked database is used to estimate the burden of work-related MVCs in Utah.

1. Project Purpose

Compare and estimate the magnitude of work-related MVCs in Utah using CODES data. As part of a collaborative effort with colleagues from Brigham Young University, we sought to describe the role MVCs play in occupational-related morbidity and mortality. The target audience was traffic safety researchers, injury researchers, and traffic safety advocates.

2. Methodology

Data Used

Utah crash reports probabilistically linked to emergency department and inpatient discharge records were used to identify work-related MVCs in 2006 and 2007.

Procedure

Work-related MVCs were identified using vehicle body type in the MVC database and cause of injury codes (E-Codes) and payer codes in the hospital database. Summary statistics and capture-recapture methods were used to describe and estimate the impact of work-related MVCs. The database was further limited to injured persons 16 or older, due to our focus on occupational injuries.

3. Results

There were 1,597 occupants in the MVC database and 1,673 patients in the hospital database identified as being in a work-related MVC. After linking the full MVC and hospital databases, 1,443 linking persons were identified as injured in a work-related MVC: 314 were identified as such in both databases, 464 were identified as such in only the MVC database, and 665 were identified as such in only the hospital database. We found that 38.7 percent of occupants injured in work-related MVCs identified in the MVC database did not have a primary payer code of workers compensation in the hospital database and 40.0 percent of patients injured in work-related MVCs identified in the hospital database did not meet our definition of a work-related MVC in the MVC database. We estimate the population of persons injured in work-related MVCs to be between 1,852 and 8,492 within Utah for the years 2006 and 2007. Thus, research on single databases may lead to biased interpretations of work-related MVCs, but combining databases may still result in an underestimate.

4. Discussion

This study resulted in a manuscript and has been accepted for publication in Traffic Injury Prevention. The abstract can be accessed at: www.tandfonline.com/doi/abs/10.1080/15389588.2012.658480
Additionally, this research was presented at the 2011 American Public Health Association (APHA) annual meeting.
The Coalition for Utah Traffic Safety (CUTS) has expressed interest in this study and has requested a copy of the manuscript upon publication.
We are using the results from this study to advocate for access to the worker's compensation database to further study work-related MVCs.

CRASH OUTCOME DATA EVALUATION SYSTEM
Promising Practice Applications Using CODES Data

Reducing Young Driver Crashes, Injuries, and Fatalities on Virginia Roadways

Virginia CODES, 2012
Virginia Highway Safety Office at Dept. of Motor Vehicles/Virginia Health Information

Abstract

In an effort to reduce young driver crashes, injuries and fatalities, an analysis was conducted of all available crash, conviction and CODES hospitalization data.

1. Project Purpose

To identify factors associated with 15- to 19-year-old-driver fatalities and injuries in order to assist in the formulation of action plans to reduce them. Target audience includes policy makers, legislators, driver's education instructors and parents. Young driver crashes increased from 3,889 to 4,045 (4%) and injuries rose from 4,118 to 4,266 (4%). Even though fatalities decreased, 29 young drivers still lost their lives on Virginia roadways.

2. Methodology

Data Used

This analysis used imputed 2008-2009 crash/hospital data, 2008-2009 inpatient level data as well as DMV crash/conviction data between 2007 and 2011.

Procedure

The 2008-2009 CODES imputed, averaged lengths of stay and total charges were added to DMV Virginia 15-19-year-old teen driver records.

3. Results

Young-driver crashes cost Virginia nearly $26 million in hospital charges and 2,733 days of care. As a result of our analysis, focus should be placed on five emphasis areas to address young drivers involved in crashes: (1) non-interstate roadway crashes; (2) non-restraint use; (3) falling asleep at the wheel from midnight to 9 .m.; (4) drinking during specific time periods (at night and early morning); and (5) having traffic convictions prior to the crash.

These behaviors tend to lead to young drivers committing other violations such as speeding and driving recklessly; making them more likely to be involved in future crashes. Reducing the number of 15- to 19--year-olds hospitalized from a crash by 3 percent would result in a cost savings of nearly $400,000 in hospital charges and avoid over 40 total hospital days.

4. Discussion

Information can be included in VAHSO education and awareness efforts; materials to train student drivers in Virginia; news releases by the Virginia DMV Communications Office and statewide conferences. A proposal for future study would be to see if 19, 20, 21-year-olds who completed a driver's education course had a lower burden of injury, death and hospitalization charges than those completing driver training before obtaining their license.

Table 5: Web Sites for State CODES Projects Profiled in Section 4

State	Web Address (current April 2015)
Connecticut	www.ct.gov/dph/cwp/view.asp?a=3137&Q=445662&PM=1
Delaware	www.dhss.delaware.gov/dph/ems/ems.html
Georgia	http://dph.georgia.gov/crash-outcome-data-evaluation-survey-codes
Illinois	www.idot.illinois.gov/transportation-system/safety/evaluations
Indiana	http://rebar.ecn.purdue.edu/crs/Project.aspx?area=2-%20Road%20Users&idarea=1
Iowa	www.idph.state.ia.us/apl/codes.asp
Kentucky	http://chfs.ky.gov/NR/rdonlyres/3F3A8820-67AA-40D9-8D14-4DBF787E5582/0/2013DRGCODES.pdf
Maine	www.maine.gov/dhhs/boh/phs/odrvs/index.shtml
Maryland	http://medschool.umaryland.edu/NSCforTrauma_codes.asp
Massachusetts	www.ecs.umass.edu/umasssafe/codes.htm
Minnesota	www.health.state.mn.us/injury/topic/topic.cfm?gcTopic=9
Missouri	http://health.mo.gov/data/mica/MotorVehicleCrashMICA/
Nebraska	http://dhhs.ne.gov/publichealth/Pages/codes_index.aspx
New York	www.health.ny.gov/prevention/injury_prevention/
Ohio	http://injuryresearch.net/codes.aspx
South Carolina	rfa.sc.gov/healthcare/fka_ors
Utah	www.utcodes.org/
Virginia	www.dmv.state.va.us/safety/

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