

Roadway Safety Data Program



MARYLAND'S DATA LINKAGE AND ANALYSIS TO SUPPORT DECISION MAKING

ROADWAY SAFETY DATA AND ANALYSIS

CASE STUDY

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EXECUTIVE SUMMARY

Highway traffic safety analysis is a multi-dimensional process involving roadway characteristics, volumes, and crash data. State agencies may encounter difficulties sharing data between agencies and integrating the multiple data sources into a single safety analysis. The University of Maryland's National Study Center for Trauma and Emergency Medical Services (NSC) receives data from several State agencies and provides integrated data analysis using the Crash Outcome Data Evaluation System (CODES) methodology. CODES helps States develop data linkage programs as crash data alone do not capture the full consequences of motor vehicle crashes. The intent of the CODES program was to provide a more comprehensive understanding of motor vehicle crashes by linking crash, vehicle, and behavior characteristics to their specific medical and financial outcomes. The purpose of this case study is to describe some of the unique qualities and successes of the Maryland CODES program and to explore how the NSC uses advanced CODES integration and safety analysis to support a variety of agencies and programs.

INTRODUCTION

Highway traffic safety analysis is a multi-dimensional process involving roadway characteristics, volumes, and crash data. State agencies may encounter difficulties sharing data between agencies and integrating the multiple data sources into a single safety analysis. The University of Maryland's National Study Center for Trauma and Emergency Medical Services (NSC) receives data from several State agencies and provides integrated data analysis using the Crash Outcome Data Evaluation System (CODES) methodology.

CODES is a State-based program created in 1992 by the National Highway Traffic Safety Administration (NHTSA), National Center for Statistics and Analysis (NCSA). NHTSA implemented the program to help States develop data linkage programs as crash data alone do not capture the full consequences of motor vehicle crashes.⁽¹⁾ The intent of the CODES program was to provide a more comprehensive understanding of motor vehicle crashes by linking crash, vehicle, and behavior characteristics to their specific medical and financial outcomes.⁽²⁾ NHTSA supported the program until 2013 anticipating that States would continue the effort using their own funding sources. In Maryland, the NSC has continued to use CODES to inform State legislation, agency policy, and behavioral countermeasure programs.

The purpose of this case study is to describe some of the unique qualities and successes of the Maryland CODES program and to explore how the NSC uses advanced CODES integration and safety analysis to support a variety of agencies and programs.

AUDIENCE

This case study applies to the following audiences:

- State Agencies: Governor's Highway Safety Program, State Department of Transportation, State Law Enforcement and State Department of Public Safety, State Legislature, TRCCs, and Office of Highway Safety.
- Local and Regional: City and County Transportation Departments, Metropolitan Planning Organizations, Regional Planning Commissions, Law enforcement agencies.
- Federal: Local and Tribal Technical Assistance Program personnel.

BACKGROUND

The NSC's mission is to prevent death and disability caused by injury and sudden illness. Established by Congress in 1986, it is part of the Shock, Trauma and Anesthesiology Research Center (STAR) in the University of Maryland School of Medicine.

The NSC staff, including epidemiologists, physicians, statisticians, and database coordinators, conducts research related to the causes, treatment, and outcomes of traumatic injury and sudden illness. NSC studies have been used to improve vehicular safety, to refine patient care and to develop public education programs for the prevention of trauma. NSC staff also collaborates with government agencies, professional associations, universities, and private

enterprises to increase understanding of trauma epidemiology and emergency medical system response.⁽³⁾

NSC staff were conducting CODES type analysis prior to joining the NHTSA program and officially joined the NHTSA program in 1994 in an effort to institutionalize their data analysis efforts.

The scope of this case study includes all public roads in Maryland and numerous agencies with whom the NSC collaborates.

Sample of Current Collaborators: ⁽⁴⁾

AAA Mid-Atlantic Foundation for Safety & Education Baltimore Metropolitan Council Centers for Disease Control and Prevention District Court of Maryland Federal Motor Carrier Safety Administration Injured Workers Insurance Fund Insurance Institute for highway Safety Johns Hopkins Bloomberg School of Public Health Maryland Department of Health and Mental Hygiene - Alcohol and Drug Abuse Administration Maryland Department of Health and Mental Hygiene - Core Violence and Injury Prevention Program	Maryland Department of Health and Mental Hygiene - Maryland Health Services Cost Review Commission Maryland Department of Public Safety and Correctional Services Maryland Motor Vehicle Administration Maryland Highway Safety Office Maryland State Highway Administration Maryland State Police Maryland Institute for Emergency Medical Services Systems National Highway Traffic Safety Administration National Safety Council – Chesapeake Regional Division National Transportation Safety Board Office of the Chief Medical Examiner U.S. Department of Transportation
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SPECIFIC GUIDELINES AND PRACTICES

NSC uses data from a variety of sources including three core data sets (crash, emergency medical services (EMS), and hospital) along with ancillary data sets such as driver licensing, vehicle registration, citation, motorcycle training, trauma registry, and others. The NSC also uses a General Use Model (GUM) of regularly collected data.⁽⁵⁾ The GUM data elements are:

- Collected by a majority of States.
- Have been mapped to standardize variables.
- Conforms with other NHTSA data systems.
- Contains rich medical information.
- Submitted on an annual basis.
- Available for analysis by NHTSA.

The NSC uses these datasets individually and collectively to conduct analyses on a variety of highway safety topics. Examples of the NSC’s analyses include:

- Fulfilling specific data query requests.

- Developing general and program-specific fact sheets.
- Producing Maryland Highway Safety Office (MHSO) annual and benchmark reports.
- Conducting problem identification.
- Improving blood alcohol content test reporting for NHTSA's Fatality Analysis Reporting System (FARS).
- Providing information and help with goal setting for the Maryland Department of Transportation (MDOT) Strategic Highway Safety Plan (SHSP) and the State Highway Administration (SHA) Highway Safety Improvement Program (HSIP) and provide data to assist with problem area prioritization for the MHSO Highway Safety Plan (HSP).

In order to fulfill the data analysis requests, NSC uses a variety of tools, including the CODES probabilistic matching software, fuzzy logic case matching rules, the SAS package for data management and analysis, and a Geographic Information System (GIS) for location-based linkage and analysis.⁽⁶⁾ One example of how they use GIS for location-based analysis is with the City of Baltimore. The city maps their own crashes and provides those GIS files to NSC for analysis. In cases where the crashes have not been mapped, NSC uses the road name variables on the crash report to identify the crash location and if appropriate, tie it to an intersection. NSC uses the CODES software to combine information from different databases into a single dataset for analysis.⁽⁷⁾ Desired information about study subjects is often contained in several databases, and if a shared unique identifier does not exist between these databases, it is not possible to combine the information directly. CODES uses probabilistic linkage to match records based on several *linking variables* that are common among all the source databases to quantify the likelihood that two or more records match. Fuzzy logic allows for matches when the values of the linking variables are similar but do not match exactly (e.g., crash time and EMS run time should be similar, but would rarely match precisely). The SAS package is a standard data management and statistical analysis tool with robust procedures for data linking and data manipulation among multiple source files. GIS is the standard for location-based data storage and reporting in Maryland.

BENEFITS

The NSC highlights the following benefits of integrated safety data and analyses:

- *Data Governance.* Agencies can feel confident in the protections afforded to them through the University's Institutional Review Board (IRB).⁽⁹⁾ Maryland CODES also has a Board of Directors that involves all agencies that provide data and meets once a year. Due to the positive relationships that have been strengthened by the CODES Board of Directors and the establishment of data use agreements, the University has been able to continue their work with these various agencies, despite the withdrawal of support from NHTSA for the CODES program.

As users (rather than owners) of the data, NSC does not have specific data QA/QC procedures in place. Rather, logistical checks are performed to identify missing information for key fields and to ensure data consistency and completeness. Based on these checks NSC may make suggestions to the agency/data owner. In one example, NSC noticed a gap in FARS data where the blood alcohol content (BAC) was not recorded in fatal crashes where the driver survived. NSC was able to provide the connection between the FARS data and trauma registries throughout the State so that the BAC could be updated.

In 2015, Maryland's Automated Crash Reporting System (ACRS) was initiated. NSC staff, along with representatives from the Maryland State Police, SHA, and MHSO, participate in the Maryland Traffic Records Coordinating Committee (TRCC) ACRS Task Force. Members of the TRCC ACRS Task force include technical and policy experts named by the Crash Data Tri-Agency Council, a subcommittee of the TRCC that includes the Maryland State Police, SHA, and MVA. The TRCC chair is selected from the participating agencies. The MHSO and the NSC share the responsibility for setting the agenda and running the meetings. These meetings tend to provide regular updates from each component of the traffic records system. The task force meets monthly and oversees continued improvements to ACRS through oversight, QA/QC, and training.⁽¹⁰⁾

- *Ability to work with agencies to answer questions and guide policy.* NSC has worked with agencies to answer questions regarding the effectiveness of programs and to provide information to guide policy decisions. NSC is analyzing the effectiveness of ignition interlocks using District Court citation data, MVA data (driver's license data, conviction data, interlock data, etc.), and crash data from Maryland State Police.
- *Early institutionalization and diverse clients.* One of the reasons why the NSC CODES program has maintained success was their ability to institutionalize prior to the completion of NHTSA support by finding supplemental funding opportunities and broadening the original intent of the CODES program. Instead of focusing on crash to hospital data, NSC understood that the agencies in Maryland had needs related to understanding the implications and effectiveness of programs, laws, and education/enforcement campaigns. Broadening the scope of data integration and analysis contributed to program stability by attracting additional agencies to the CODES program, thereby providing supplemental funding to that already provided by NHTSA.

RESULTS

Funding, processes, and lessons learned regarding the NSC implementation of CODES and data linkage and analysis are outlined below.

FUNDING

- The NSC CODES program was initially partially funded by NHTSA. However, the University received supplemental funding from the organizations that they served, such as the Maryland Motor Vehicle Administration (MVA), MHSO, SHA, and Maryland State

Police, among others. NSC is now fully funded through grants and specific requests from those agencies and organizations that receive data analysis assistance.

MARYLAND PROGRAMS AND PROCESSES USING DATA LINKAGE AND ANALYSIS

- *Crash analysis:* through their ability to analyze integrated data, NSC has conducted numerous research studies.
 - Some of the individual studies performed by NSC include one on older motorcyclists and another on lower-extremity injuries (LEI). For the older motorcyclist study, the results indicated that that older motorcyclists are significantly more likely to incur serious thoracic injuries, and that those injuries are more likely to result in death.⁽⁶⁾ With the increased use in safety belts and the addition of air bags, more motor vehicle occupants are surviving crashes however, there has been an increase in LEIs. The injury ratings provided on crash reports do not accurately reflect the long-term impacts of LEIs as many LEI require multiple surgeries and rehabilitation after the initial hospital discharge. Through their study, NSC researchers were able to provide details and implications of LEI's, including the resulting long-term physical, psychosocial, and financial impacts of LEI injuries.⁽⁸⁾ Similarly, NSC has used data linkage to conduct studies pertaining to the crashes related to driver experience and licensure and the effectiveness of motorcycle helmets.
 - NSC conducts crash analysis to support SHA with goal setting for the Strategic Highway Safety Plan and the Highway Safety Improvement Program along with providing data to assist with problem area prioritization for the Maryland Highway Office Highway Safety Plan. For the Strategic Highway Safety Plan, NSC analyzes the data for each of the emphasis areas and helps with goal setting by providing a five-year rolling average using an exponential trend line. Although the plan is updated every five years, the goals are updated annually.
- *Development of standardized reports:* NSC provides information to the MVA, MHSO's Regional Traffic Safety Program, and Maryland Legislators for the development of standardized reports. The CODES data include crash, EMS, emergency department, hospital, citation, licensing, toxicology, and vehicle registrations.⁽⁷⁾
- *Answering highway safety legislative inquiries:* NSC used various data sets related to highway safety to answer Maryland legislature inquiries regarding highway safety. Based on this data, Maryland created a Traffic Safety Fact Book modeled on one published by NHTSA along with program and county specific fact sheets.⁽¹¹⁾ NSC was also able to conduct extensive analysis of various behavioral program areas.
- *Serving as an independent organization:* the University is able to bridge organizations and bring together data from agencies that otherwise may have been analyzed separately. For example, traditionally statewide data would not include Baltimore City. However, through their separate data use agreements, NSC is able to comprehensively analyze data from both the State of Maryland and also Baltimore City.⁽¹²⁾
- *Providing data management feedback:* At times agencies also request data management feedback from NSC. NSC provided feedback on data management, validation, and analysis to SHA and the State police on the recent change to electronic crash reporting.

LESSONS LEARNED

- *Personnel:* When a program is comprised of one or two individuals, staff turnover can destabilize a program. With a larger program, knowledge of the data sharing relationships is retained, data analysis capabilities are strengthened, and overall program stability is strengthened. The way the NSC program is structured, there is a larger staff comprised of programmers, statisticians, epidemiologists, etc., all funded through various grants and other projects.
- *Institutionalization and funding:* Because the NSC CODES program institutionalized early after its inception, by broadening the types of analyses conducted and finding funding sources, they were able to sustain the program after NHTSA's support ended. Institutionalizing early also facilitated bringing in additional datasets and garnering buy-in and funding from other agencies.
- *Data sharing agreements:* While NSC staff have been able to draw on established relationships, the University has formalized those relationships with data use agreements and the creation of an oversight board, the CODES Board of Directors, comprised of data-owners. The establishment of these agreements and creation of the oversight board facilitated the access and analysis of data throughout the State.

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EXPLANATION OF TERMS

Crash Outcome Data Evaluation System (CODES) is a program originated by the National Highway Traffic Safety Administration (NHTSA) that involves a statistical methodology to augment State crash data with medical outcome data using probabilistic linkage.⁽¹³⁾

General Use Model (GUM) is a model created to bring together and synchronize data collected from multiple States. The CODES Technical Resource Center worked with NHTSA's State Data System and the CODES Data Network to develop a standardization model that mapped State-specific crash files onto a standardized format called the General Use Model (GUM).⁽¹³⁾

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