CODES GRANT at IDOT

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The National Highway Safety Administration (NHTSA) recently awarded the Illinois Department of Transportation (IDOT) about $281,000 to develop a CODES (Crash Outcome Data Evaluation System) program in Illinois. This project will be based on collaboration between IDOT and the Illinois Department of Public Health (IDPH). Under this grant, IDOT will link existing traffic crash records with health care data sources from EMS, trauma registry, hospital discharges, and vital records (death certificates). The linked database will be used to support local, regional and statewide highway safety decision-making to affect decreases in deaths, non-fatal injures (e.g., head, neck, upper extremity and lower extremity), and health care costs resulting from motor vehicle crashes. Individual databases are not always adequate for certain analyses (e.g., race and ethnicity, socioeconomic status). Two sources, law enforcement and public health track victims separately.
None of the health-related data are linked back to crash data.

Originally, CODES evolved from the ISTEA 1991--ISTEA mandated that NHTSA to prepare a report to Congress about the benefits of safety belt and helmet use. NHTSA sponsored the CODES projects and awarded grants to several states to link their databases. The linked database will have the following advantages:

- Collaboration of traffic safety and health care communities
- The linked data can be used by multiple users for different purposes.
- The linked data process results in increased data quality.
- Linking data encourages standardized and computerization of state data.
- Linked data can be disaggregated to provide information to local communities.
- Linkage enhances the value of each state data file being linked by expanding the comprehensiveness of each state data set.
- Linkage provides access to more detailed medical information for highway and traffic safety evaluation; and linkage provides more detailed safety information for injury control purposes.
- The CODES system helps states by linking data so that it is available to them to identify specific crash, vehicle and behavior characteristics that lead to increased risk of injury severity and high health care costs in their states. Applications for this information then can be developed to support state-specific decision-making

Reasons for Linking the Existing Databases

Currently, the crash database as well as a few small local databases, citation data, limited health care data, and the exposure data (population and vehicle miles of travel) are used to identify traffic safety problems and evaluate the highway safety programs and projects. The Evaluation Unit within the Division of Traffic Safety is responsible for problem identifications, developing highway safety goals and objectives, and evaluating highway safety programs and projects.

Unfortunately, the current databases that the Division uses to identify its highway safety problems and evaluate the existing highway safety goals and objectives are limited since

the crash database does not contain the true outcome data, such as medical and financial items. By linking each person identified on the police crash report who is injured to one or more medical records will provide a rich new source on outcomes. The linked data allows for identification of specific types of injuries (head, neck, lower extremity, and upper extremity), severity of injury (required hospitalization), cost of injury (hospital charges), payment source (Private, Medicare, Medicare, and uninsured) and medical system response (EMS response time, transfer, hospitalized). Data available in hospital discharge abstracts and death certificate records includes ICD-9 (International Classification of Disease) coding which allows for more precise identification of the nature and severity of injury than the police are qualified to report accurately. The linked data will provide a comprehensive data base for conducting several types of studies that benefit the highway safety program in Illinois. In addition, the linked data will allow us to identify the main data issues and try to improve overall quality of traffic safety related databases. Based on the information and data provided by those states that have linked their databases, the linked database also will provide legislators additional information for traffic safety related issues, such as alcohol and safety belt and helmet use.

Data Request for CODES Project

Illinois Department of Transportation, Division of Traffic Safety is requesting all injury and mortality data from five databases, namely Hospital Discharge Data, Trauma registry, Spinal Cord Injury Registry, Emergency Medical services data, and Death Certificates for the last two years (Calendar Years **2002 and 2003**). **The injury related ICD-9 codes include all diagnoses (principal and other diagnoses) from 800 to 959.9. The requested data items from each database are list in Table 1.**

Using the following the existing linkage variables shown in **Table 2**, this project will link the existing statewide traffic records (from the Illinois Department of Transportation) with medical outcome and medical charge data (from the Illinois Department of Public Health). The linked database will be used to support local, regional and statewide highway safety decision-making to affect decreases in deaths, non-fatal injuries, and health care costs resulting from motor vehicle crashes. Illinois Department of Transportation, Division of Traffic Safety will commit state resources to sustaining the linkage and analysis of state crash, cost and outcome data beyond the scope of the initial project by NHTSA.

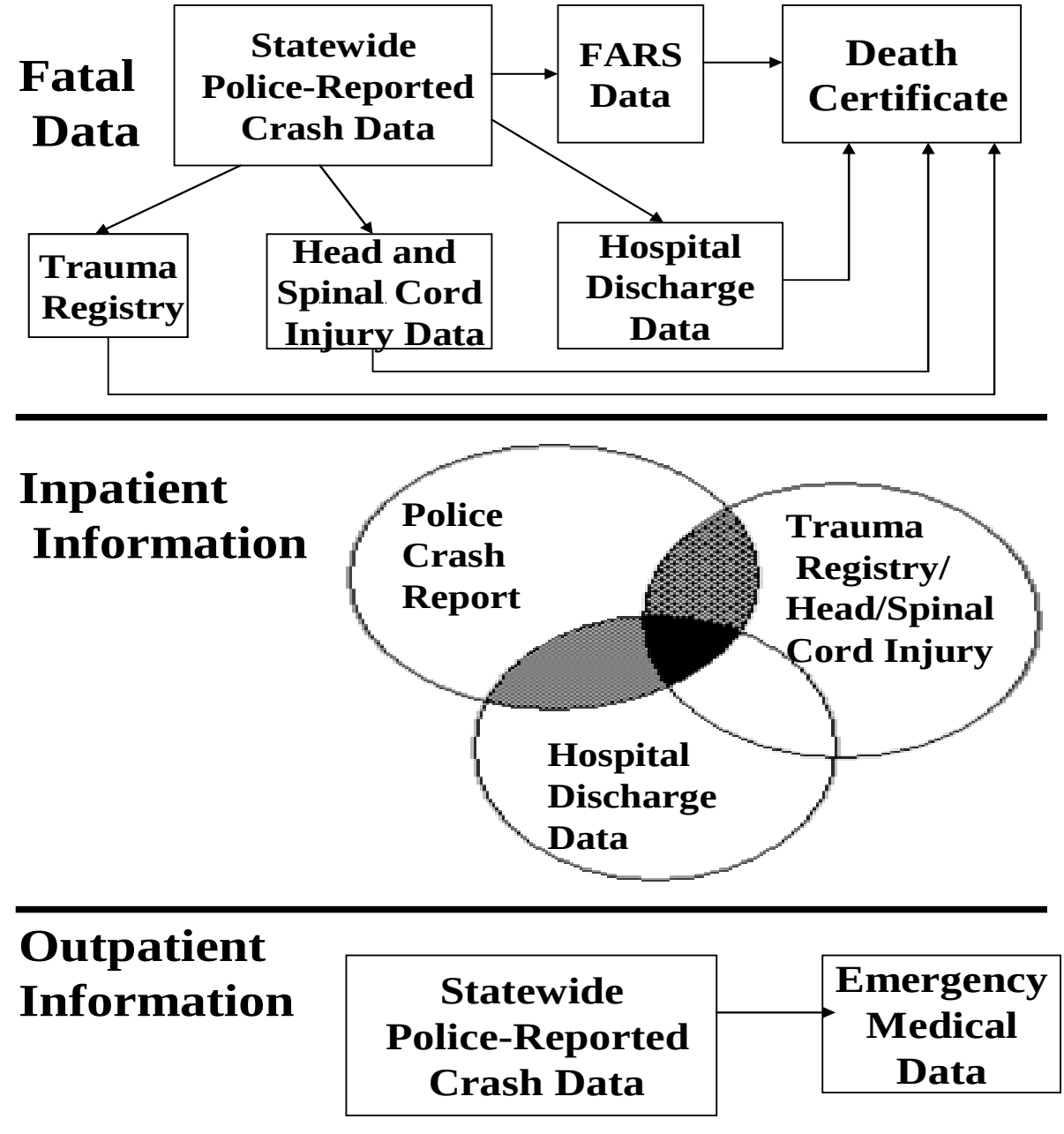
The proposed data linkage model is shown in the following Figure 1.

Table 1: Requested Data Items from Five IDPH Databases					
Data Files	Hospital Discharge Data	Trauma Registry	Spinal Cord Injury	Emergency Medical Services	Death Certificates
Crash Date	NA	X	X	X	NA
Crash Time	NA	X	X	X	NA
Name	NA	X	X	X	X
SSN	NA	X	X	NA	X
Crash Location	NA	X	X	X	NA
Patient Zip Code	X	X	X	X	NA
County Code	X	X	X	X	X
City Code	X	X	X	X	X
Age	X	X	X	X	X
Date of Birth	X	X	X	X	X
Date of Death	If it applicable	If it applicable	If it applicable	If it applicable	X
Gender	X	X	X	X	X
Race	NA	X	X	X	X
Patient Zip codes	X	X	X	X	NA
Primary Payer	X	X	X	X	NA
Secondary Payer	X	X	X	X	NA
Admit Date	X	X	X	X	NA
Admit Source	X	X	X	X	NA
Type of Admit	X	X	X	X	NA
Discharge Date	X	X	X	X	NA
Length of Stay	X	X	X	X	NA
Principal Diagnosis	X	X	X	X	NA
Other Diagnosis	X	X	X	X	NA
ICD-(E-Code)	X	X	X	X	X
DRG Code	X	X	X	X	NA
MDC	X	X	X	X	NA
Total Charges	X	X	X	X	NA
Room and Board Charges	X	X	X	X	NA
Discharge Status	X	X	X	X	NA
Hospital ID	X	X	X	X	NA
Hospital Zip Code	X	X	X	X	NA

Table 2: Databases to be Linked and Key Variable Coded on Each Selected Data Sources

Data Files	Crash Date	Crash Time	Name	SSN	Age	County	Crash Location	Patient Zip Code	Payment Source	ICD-9 Codes	ICD-9 E-Codes
Crash	X	X	X		X	X	X				
FARS	X	X	X		X	X	X				
EMS	X	X	X		X	X	X	X	X	X	X
Trauma Registry	X	X	X	X	X	X	X	X	X	X	X
Head & Spinal Cord Injury	X	X	X	X	X	X	X	X	X	X	X
Hospital Discharge					X	X		X	X	X	X
Death Certificate			X	X	X	X					X

Figure 1: Proposed CODES Data System for the State of Illinois



CODES2000 Software for Linking the Existing Data Base

The CODES 200 software was developed by Strategic Matching, Inc. which has a contract with the National Highway Traffic Safety Administration to assist the those states that have been awarded a CODES grant to link their existing crash and medical databases . The software uses the indirect linkage variables (e.g., name, date of birth, date of crash, county, city, and some other common variables) to match the crash victims with their medical records in order to understand medical consequences of motor vehicle injuries and fatalities. The software uses a Bayesian Statistical Theory to calculate the probability of an uncertain claim in light of prior information and new experimental evidence. It is a Probabilistic Records Linkage Software that includes effective algorithms for data preparation, analysis, and comparison. Examples of the probabilities are shown in the following tables.

Probability=.9999

File	Date	Time	City	DOB	Sex
Crash	June 2	10 AM	Chicago	5/10/2	
EMS	June 2	10 AM	Chicago	5/10/2	M

Probability=.733

File	Date	Time	City	DOB	Sex
Crash	June 2	10 AM	Chicago	5/10/2	
EMS	June 2	10 AM		5/10/2	M

General Requirement for the CODES Project

Each participating agency will send staff for training in the use of the linkage software, and for other training relevant to the success of this CODES project

In order to focus on data as current as possible, the data to be linked in this project will be the 2002 and 2003 currently available from all data holders. The 2004 database will be available after this is nearly ready for linkage (and will be ready during the fall of 2005. This project will focus on 2001 and 2002 data to test the system.

Illinois plans on employing a client-server system for containing the linked data. With a client-server system, we will be able to grant access to individuals from various agencies to work with the linked data concurrently. This ability to work with the data will enhance cross training, so that a number of individuals that will be familiar with the linked client-server data base. We also plan on encouraging several collaborative efforts that will employ individuals from the various agencies; this should also enable cross training in the understanding and manipulation of the data.

The Division of Traffic Safety at IDOT will purchase the computer and the new data linkage software dedicated to CODES activities. The computer and software will be transportable; subject to the direction of the CODES Board of Directors, the hardware and software will be located so as to most effectively accomplish the goals and objectives of the CODES project.

The Division of Traffic Safety will conduct the validation studies and will calculate rates of false positives and false negatives among the linked and unlinked records.

Sustainability--The project funds requested will enable initial linkage of data bases from two calendar years (2002 and 2003). During this project, the file preparation and linkage and validation processes will be documented so as to assure sustainability. Illinois is committing to fund ongoing linkage after the cessation of federal funding. Both as part of this project and in the years to follow, Illinois will provide NHTSA with a copy of the linked data file, pursuant to state and federal confidentiality provisos, so as to extend the national linked data base.

Data dissemination--The linked data will be published in accessible formats. This will include web and internet access, as well as paper production.

Illinois plans to institutionalize CODES as a regular means for data linkage and analysis. We plan on using the linked data to: 1) identify highway safety problems, 2) develop highway safety goals and objectives, 3) allocate highway sources appropriately, and 4) evaluate highway safety projects and programs in Illinois. CODES will be a valuable tool to the state legislature to support or dismiss certain legislative initiatives. Having CODES institutionalized will allow us to analyze safety initiatives and new laws as to their impacts. The linked data will allow us to conduct cost/effective analyses on several issues including unbelted versus belted occupant, types of injuries, and helmeted versus not helmeted motorcyclists. Based on the data and information from those states that have linked their databases, the linked data also helped them to improve their data quality including, timeliness, accuracy and completeness as well as the accessibility that

resulted in identifying of highway safety problems and developing appropriate action plans to reduce motor vehicle fatalities and injuries and associated costs.

The CODES Board of Directors and the CODES Advisory Committee will assure that the linked data are provided to state agency directors, planners, users and legislative committees, charged with developing and implementing prevention and control programs and policies. The Directors (meeting monthly through project duration) and the Advisory Committee (meeting three times through the duration of the project) will provide oversight regarding the technical aspects of the collaboration necessary to ensure data linkage; these groups will also give direction regarding the analysis and interpretation of the linked data.

The CODES Board of Directors are Included in the State Traffic Records Coordinating Committee. In Illinois we have statewide traffic Records Coordinating Committee which has several members in a variety of highway safety research and medical outcome/cost areas. The team members have experience in developing and using large volumes of multidisciplinary data (crash file, medical files, population and vehicle miles of travel), experience in linking files, performing statistical analyses and evaluation analyses of linked data using highway safety databases, and experience in evaluating safety belt and helmet effectiveness using highway safety databases.

IDOT Personnel

Project Director (Mehdi Nassirpour, Ph.D.). Mehdi Nassirpour is the Chief of Research and Evaluation Unit, Division of Traffic Safety at the Illinois Department of Transportation. He received his Ph.D. in Demography and Applied Statistics from the University of Illinois at Urbana-Champaign. Dr. Nassirpour is experienced in the conduct of studies involving record linkage of large complex computerized data bases. Prior to his current position, he was the director of research and Development at the Illinois Health Care Cost Containment Council where the Illinois Hospital Discharge data resided before 2002. His professional experience in research/development includes over 20 years in highway safety and health services research/planning and management with the State government as a research associate, project manager, and director of research/development. He is experienced with large-scale data collection, designing, computer analysis of data, modeling and writing reports on findings. In 1998, he started the statewide Traffic Records Coordinating Committee in Illinois and worked closely with other state data holder to share data and information. Nassirpour has managed several research projects and has been adjunct professor at the local universities. He has taught courses in Applied Statistics, Research Methods, and Applied Sampling. He has been a member of several highway safety and health-related organizations and presented several papers at both at the state and national conferences and published several technical articles in professional journals. Among his accomplishments, relevant to this project, were three main studies completed for the Illinois Department of Public Aid: 1) Comparing Medicaid Mothers and Babies to Non-Medicaid Recipients, 2) Infant Mortality Rate and Its Correlates Among the Medicaid Population in Illinois. For the purpose of these two studies, a linked Birth-Death Master files were matched against the Illinois Department of Public Aid (IDPA) client database in order to identify the Medicaid newborns and infant deaths. The linkage variables included newborn's name, date of birth, sex of the child and mother's name, and mother's date of birth