



Figure 4. Boxplot of Injury Severity Scores (ISS) in the HCUP Emergency Department records compared to injury severity entered in the crash report.

DESCRIPTIVE ANALYSIS

The following sections provide results from descriptive analyses of the 2016-2020 CODES dataset including characteristics of the linked records (Table 10) and several safety emphasis areas (alcohol involvement, older drivers, occupant protection, and teen drivers).

The median age of the linked dataset was 36, with a range of 0-99 (Table 10). The dataset had slightly more males (51.4%) compared to females (47.6%) and included 1.1% unknown gender. Nearly three-quarters of the linked persons were white (74.0%), followed by Black (7.9%), and Hispanic (5.2%). Asian or Pacific Islander and Native American racial groups made up less than 2% of records combined. However, 10.4% had unknown race. Most linked persons were drivers (76.7%) or passengers (20.2%) in the crash and 3% were non-motorists.

Nearly half (48.2%) of the linked persons were indicated as 'possible injury' in the crash report, followed by minor injury (39.6%), and severe injury (10.7%). One percent of the linked persons were recorded as having died in the crash report.

OCCUPANT PROTECTION

In the table below, restraint status refers to whether the linked occupant is restrained or not with some known form of vehicle occupant protection. To directly compare known restrained individuals with known non-restrained individuals in vehicles, all vehicle occupants with unknown restraint status are excluded. Non-motorists are also excluded.

Of the vehicle occupants with known occupant protection status linked to HCUP data (total N = 34,893), 88% were known to be restrained. In the Emergency Department (SEDD) records, the average cost per person is over \$3,000 higher for a vehicle occupant who was not restrained versus one who was restrained. In the Inpatient (SID) records, the average cost per person is \$25,278 higher for a vehicle occupant who was not restrained versus one who was restrained. Combining costs for SID and SEDD records, the average hospital cost per person is \$21,899 higher for a vehicle occupant who was not restrained versus one who was restrained. Compared to individuals who were known to be restrained, a greater proportion of individuals who were known to not be restrained were linked to an Inpatient record rather than just an Emergency Department record.

Table 15. Hospital costs by Restraint Status

	Not Restrained N = 4,161		Restrained N = 30,713	
	Total Charges (USD)	Avg. Charges per person (USD)	Total Charges (USD)	Avg. Charges per person (USD)
SEDD	28,596,800	8,251	150,877,601	5,198
SID	106,720,132	94,193	175,320,349	68,915
Overall	135,316,932	32,520	326,197,950	10,621
*A total of 30,732 linked individuals were restrained; however, 19 were missing hospital charge data and were not included in this table.				

Table 16. Record Type, LOS, and Discharge Disposition by Restraint Status

	Not Restrained N = 4,161	Restrained N = 30,732
Record Type		
Both	438 (10.5%)	856 (2.8%)
SEDD Only	3,028 (72.8%)	28,188 (91.7%)
SID Only	695 (16.7%)	1,688 (5.5%)
Length of Stay (SEDD)		
0	2,778 (80.2%)	26,064 (89.7%)
1	619 (17.9%)	2,680 (9.2%)
2	52 (1.5%)	224 (0.8%)
3+	17 (0.5%)	76 (0.3%)
Length of Stay (SID)		
0	43 (3.8%)	67 (2.6%)
1	145 (12.8%)	373 (14.7%)
2	156 (13.8%)	435 (17.1%)
3+	789 (69.6%)	1,669 (65.6%)

Discharge Disposition (SEDD)		
AMA/Unknown	23 (0.7%)	151 (0.5%)
Died	100 (2.9%)	70 (0.2%)
Routine/Discharge Alive	2,639 (76.1%)	27,479 (94.6%)
Short-Term Hospital	621 (17.9%)	1,122 (3.9%)
Transfer Other	83 (2.4%)	222 (0.8%)
Discharge Disposition (SID)		
AMA/Unknown	*	11 (0.4%)
Died	65 (5.7%)	78 (3.1%)
Routine/Discharge Alive	686 (60.5%)	1,603 (63.0%)
Short-Term Hospital	*	59 (2.3%)
Transfer Other	341 (30.1%)	793 (31.2%)

TEEN DRIVER CULPABILITY ANALYSES

During this performance period a paper titled “Direct medical charges of all parties in teen-involved vehicle crashes by culpability” was published using the Iowa CODES 2016-2020 dataset. The paper is available here: <https://injuryprevention.bmj.com/content/29/4/334> The abstract of the paper is included below:

Background: Motor vehicle crashes among teen drivers often involve passengers in the teen’s vehicle and occupants of other vehicles, and the full cost burden for all individuals is largely unknown. This analysis estimated direct hospitalisation and emergency department charges for teen-involved crashes by teen culpability, comparing charges for the teen driver, passengers and occupants of other vehicles.

Methods: Probabilistic linkage was performed to link the Iowa police crash reports with Iowa emergency department and Iowa hospital inpatient data. Teen drivers aged 14–17 involved in a crash from 2016 through 2020 were included. Teen culpability was determined through the crash report and examined by teen and crash characteristics. Direct medical charges were estimated from charges through linkage to the Iowa hospital inpatient and the Iowa emergency department databases.

Results: Among the 28 062 teen drivers involved in vehicle crashes in Iowa between 2016 and 2020, 62.1% were culpable and 37.9% were not culpable. For all parties involved, the inpatient charges were \$20.5 million in culpable crashes and \$7.2 million in non-culpable crashes. The emergency department charges were \$18.7 million in teen culpable crashes and \$6.8 million in teen non-culpable crashes. Of the \$20.5 million total inpatient charges in which a teen driver was culpable, charges of \$9.5 million (46.3%) were for the injured teen driver and \$11.0 million (53.7%) for other involved parties.

Conclusions: Culpable teen-involved crashes lead to higher proportions of injury and higher medical charges, with most of these charges covering other individuals in the crash.

NEXT STEPS

1. Obtain date of birth information for individuals involved in crashes during 2021, join it with the rest of the crash data, and link the crash data to the 2021 Emergency Department and Inpatient hospital data from HCUP.
2. Pursue obtaining missing zip codes for non-motorists involved in crashes from 2016 to present
3. Modify (or consider modifying) CODES linkage to
 - a. Omit persons who died at the crash scene or who were transported to an out-of-state hospital prior to linkage
 - b. Further restrict e-codes to motor vehicle crashes specifically
 - c. Capture multiple visits to unique hospitals (i.e., transfers) associated with the same crash event
 - d. Export and examine match quality metrics
 - e. Examine match quality metrics and adjust criteria to relax or tighten as necessary
4. Report missingness within relevant HCUP data elements, linkage variables, and outcome measures of interest (ICD-10 CMs to calculate ISS, LOS, costs).

5. Investigate how to calculate ISS scores for individuals linked to both Emergency Department and Inpatient data.
6. Conduct adjusted analyses to examine 2016-2021 vehicle crash outcomes in relation to:
 - Benefits of safety devices (e.g., seat belts, helmets)
 - Medical and economic burden estimates
 - Trends in vehicle crashes and related injury outcomes for high-risk and vulnerable road user populations, specific injury types, and specific crash and vehicle characteristics (e.g., older drivers, motorcyclists, traumatic brain injuries)
7. Integrate justice (charge/conviction data) with CODES data

CONCLUSION

During this performance period, our team made continued progress toward our objectives of building a comprehensive CODES dataset and analyzing outcomes related to motor vehicle crash-related injuries in the State of Iowa for different populations and safety emphasis areas. We improved and examined the quality of the probabilistic linkage to join the Iowa police crash report data with Iowa Emergency Department data, Iowa Hospital Inpatient data, and FARS fatal motor vehicle crashes from 2016 through 2020. The current set of linkage variables resulted in unique combinations (i.e., only one individual in the dataset had that combination) for 98.3%, 92.2% and 95.7% of the crash, Emergency Department, and Inpatient records, respectively.

The linkage yielded probabilistic matches to the hospital data for 44% of the crashes. Considering only the injured persons who were reported as transported by EMS from the crash scene, about 70% were linked to hospital records. Within this group of linked individuals, the quality of the matches seems to be quite good, as the hospital information entered in the crash report corresponded with the hospital identifier in the hospital data nearly 90% of the time. However, there is additional room for improving the number of linked records, particularly with regard to the other 30% of injured persons transported by EMS who were not linked to hospital records.

During this course of this performance periods, as with several other past projects funded by GTSB and completed by investigators at the University of Iowa, as we cleaned the data in preparation for linkage and attempted to analyze the data, we discovered a number of new data quality issues. In this year specifically, these have hampered our progress on linking more recent crash data to Emergency Department and Inpatient hospital data and on our ability to evaluate crash outcomes for non-motorists.

Appendix A

Iowa's 2023 CODES Project Personnel

Conducted by the University of Iowa Injury Prevention Research Center
Under contract to Iowa Governor's Traffic Safety Bureau and Iowa Department of Transportation

Key Investigators

Cara J. Hamann, MPH, PhD
Associate Professor
The University of Iowa Injury Prevention Research Center

Michelle Reyes
Senior Research Associate
University of Iowa Driving Safety Research Institute

Jonathan Davis
Research Assistant Professor
The University of Iowa Injury Prevention Research Center

Data Analysts

Ling Zhang
Stephanie Jansson

Research Team

Ryan Dusil
Corinne Peek-Asa
Elizabeth O'Neal

GTSB Contact

Mick Mulhern