

**A COMPARISON OF IOWA CRASHES
INVOLVING OLDER DRIVERS
USING LINKED DATA**

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Crash Outcome Data Evaluation system

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Table of Contents

Executive Summary	1
Background	2
Methods	2
Results: Crash Involvement Factors	3
Results: Hospitalization Outcomes	4
Summary and Recommendations	5
Table 1: Comparison of Outcome Measures by Age Group	7
Table 2: Crash Time and Road Condition by Age Group	9
Table 3: Type of Road Where Crash Occurred by Age Group	10
Table 4: Other Crash and Vehicle Characteristics	11
Table 5: Driver Characteristics and Behavior by Age Group	12
Table 6: Results of Logistic Regression Predicting Hospitalization	13

Executive Summary

Using Iowa police crash reports linked to statewide hospital inpatient data, we analyzed crashes for older drivers (age 65 and over) compared to middle-aged (age 25-64), and young drivers (under age 25).

- While less likely to be involved in crashes, Iowa's older drivers were more likely to be hospitalized if they were in a crash; their rate of hospitalization per licensed driver was 1.4 times that of middle-aged drivers.
- While older Iowa drivers represented 10.4 percent of the drivers involved in crashes, they accounted for 21.1 percent of the Iowa drivers who were hospitalized.
- Within the older driver group rates of injury, hospitalization increased with age; drivers age 75 and over accounted for 46.3 percent of the older drivers involved in crashes but 55 percent of older drivers hospitalized.
- Older drivers were more likely than middle-aged drivers to be involved in crashes in urban areas (79.8% vs. 75.5%), at intersections (50.1% vs. 42.9%), driveways (8.6% vs. 6.9%), and at lower speeds of 25-35 m.p.h. (41.4% vs. 34.7%) than middle-aged drivers.
- Older drivers were more likely than middle-aged drivers to be making a left turn (5.2% vs. 2.7%), or have failure to yield (22% vs. 10.7%). They were somewhat less likely to have driver inattention or distraction (1.1% vs. 1.7%) noted on the crash record.
- While older drivers had a higher proportion of crash involvement in urban areas (79.8%), the highest proportion of hospitalizations were in crashes in rural areas (60.2%).
- Crashes where the vehicle ran off the road were a small proportion of older driver crashes (7.2%), but a high proportion of older driver hospitalization (34.7%).
- For older drivers the risk of hospitalization increased by 2.5 percent for every one-year increase in age.
- Although more male drivers were involved in crashes, older female drivers were slightly more likely to be hospitalized during a crash than were older male drivers.
- Older drivers not wearing seat belts were 8.16 times more likely to be hospitalized than were older drivers who were wearing seat belts during a crash.

Background

Nationally, older drivers represent an increasing percentage of licensed drivers. **“In 2008, older people accounted for 15 percent of all traffic fatalities and 18 percent of all pedestrian fatalities.”** (source: Older Population, Traffic Safety Facts 2008, NHTSA document DOT HS 811 161). This is an important issue in Iowa, which has a higher proportion of population age 65 and over (15%) compared to the national average (13.3%). The number of Iowa residents age 65 and over has increased from 436,213 during 2000 to 452,888 during 2010 (source: Profile of General Demographic Characteristics for Iowa, U.S. Census, 2011). As of 2012, 420,663 (18.5%) of the licensed drivers in the state of Iowa were age 65 or older (source: Office of Driver Services, Iowa Department of Transportation, May, 2012).

Methods

Statewide police crash reports for Iowa in 2010 were linked to statewide hospital inpatient discharge. During 2010, of the 93,723 persons reported in crash records, 944 were linked to hospital inpatient discharge.

The study selected Iowa-licensed drivers of passenger cars, vans, and light trucks) involved in crashes on Iowa highways during 2010 (N=67,280). Drivers licensed out of state were excluded from the analysis.

For comparative purposes, driver’s age was grouped into three age groups: less than 25 (young drivers), 25-64 (middle-aged drivers), and 65 and over (older drivers). A variety of crash (rural/urban location, road type, light conditions, pavement conditions) and driver behavior factors (failure to yield, distracted) were evaluated. The analysis focused on comparisons of the number of Iowa drivers involved in crashes with the number who were hospitalized (based on the linked data).

The analysis consisted of population-based rates per licensed driver and comparisons involving crash demographics, characteristics, and driver behavior. In addition a multivariate logistic analysis of hospitalization and death outcomes in crashes was prepared.

In the absence of unique identifiers, linked data were based on probabilistic linkage methods. These methods were dependent on the completeness and accuracy of other information (date and time of crash, date of birth, zip code of residence, and town code of crash location) which were available in the police crash reports and hospital discharge. The linkage was based on automated linkage without clerical review for individual records. This system undoubtedly produced some false negative matches due to errors or missing data on one side or the other of the targets of the linking process. The numbers provided in this report, while useful in comparing patterns of injury and medical cost, underestimate the full burden of injury and medical cost.

Results – Crash Involvement Factors

Of the 78,021 Iowa-licensed drivers involved in crashes during 2010, 8,130 were age 65 or older (Table 1). Per 100,000 licensed drivers, the rate of crash involvement was lower (1932.7) than the rate for young (6,606.8) or middle-aged drivers (3,095.2).

Older drivers were more vulnerable to serious injury resulting in a rate of hospitalization per 100,000 that was much higher (23.3) than for middle aged drivers (16.8). While older Iowa drivers represented 10.4 percent of the drivers involved in crashes, they accounted for 21.1 percent of the Iowa drivers who were hospitalized. Within the older driver group rates of injury and hospitalization increased with age; drivers age 75 and over accounted for 46.3 percent of the older drivers involved in crashes but 55.1 percent of older drivers hospitalized. Within the older driver group, drivers age 75 and over accounted for 56 percent of the inpatient charges.

Results of our assessment of crash and driver factors are reported in Tables 2-5. While the number of crashes did not vary that systematically based on day of week, older drivers were less likely to be involved in crashes on the week end than during the week. Only on Saturday did they make up less than ten percent of total crashes. While all age groups experienced more crashes in the winter months, those drivers age 65 and older made up a lower percentage of total crashes (51.5%) involved in crashes during the colder months, October-March, than those age 25 to 64 years (57.8%) (Table 2). Since these were Iowa crashes, this could be related to older drivers who reside in the south for parts of the winter or older drivers actually driving less during the winter months.

Older driver crashes were more likely to occur during daylight hours (84.6%) compared to middle-aged drivers (71.1%). Older drivers were less likely to be involved in crashes on wet, snow covered, or icy roads (26.2%) than middle-aged drivers (34.9%); this result correlated with fewer crashes during the winter months.

Table 3 provides information on the road locations where the crashes took place. Older drivers were more likely than middle-aged drivers to be involved in crashes in urban areas (79.8% vs. 75.5%), at intersections (50.1% vs. 42.9%), driveways (8.6% vs. 6.9%), and at lower speeds of 25-35 m.p.h. (41.4% vs. 34.7%).

Table 4 provides information on other crash and vehicle characteristics. Older drivers were less likely to hit an animal (2.3%) than middle-aged drivers (3.5%); this result correlated with fewer crashes during the night when most animal-related crashes take place. Older drivers were more likely to be involved in multiple vehicle crashes (85.5% vs. 78.9%) than were middle-aged drivers. Older drivers were less likely to be driving a light truck or van (40.3% vs. 51.8%) than were middle-aged drivers, although young drivers were even less likely to do so (29.9%). The rate of passengers riding with older drivers during crashes (28.1%) was similar to middle-aged drivers (28.2%), but lower than the rate for young drivers (34.3%).

Table 5 provides information on the characteristics and behavior of drivers before and during the crash. Older drivers in crashes were more likely to be male (55.2%) which was only slightly different from middle-aged drivers (52.4%). Seat belt use, as reported to or by the police, was

also similar (68.4% vs. 66.7%). Older drivers were more likely than middle-aged drivers to be making a left turn (5.2% vs. 2.7%) or have failure to yield (22.0% vs. 10.7%).

Older drivers were less likely to be driving at an illegal or unsafe speed (2.5% vs. 5.5%) or using drugs or alcohol (0.6% vs. 3.2%) than middle-aged drivers. As a function of their age, older drivers were more likely to be ill, handicapped, and have license restrictions (special equipment, medication, daylight only, corrective lenses) than middle-aged drivers involved in crashes.

Results – Hospitalization Outcomes

As reported above, older drivers had higher rates of more serious injuries resulting in hospitalization. Tables 2-5 also report the distribution of the 98 older drivers who were linked to a hospital inpatient record. Using hospitalization as an outcome measure provided a very different view of the important crash factors for the older drivers.

While older drivers had a higher proportion of crash involvement in urban areas (79.8%), the highest proportion of hospitalizations were in crashes in rural areas (60.2%) (Table 3). While the highest volume of crashes occurred on roads with posted speed limits of 25-35 m.p.h. (41.4%), the highest volume of crashes resulting in hospitalization were on roads with posted speed limits of 45-55 m.p.h. (45.9%).

Crashes where the vehicle ran off the road were a small proportion of older driver crashes (7.2%), but a high proportion of older driver hospitalization (34.7%) (Table 4).

Older drivers in vans and pickups were less likely to be hospitalized than were older drivers in passenger cars. However, whether there were passengers in the vehicle made no difference. Older drivers with passengers in the vehicle represented 28.1 percent of crashes and represented 31.6 percent of those where hospitalization occurred.

While older female drivers were less likely than males to be involved in a crash (44.4%), they were more likely than males to be hospitalized (51.0%) (Table 5). Older driver's reported as not wearing a seat belt were associated with a higher proportion of hospitalization than would be predicted by the rate of crash involvement (12.2% vs. 1.3%).

The multivariate logistic regression supported most of these findings (Table 6). During crashes of older Iowa drivers the odds ratios of hospitalization was higher due to the driver not being belted (8.16), a rural crash location (6.68), a speed limit increase of 10 m.p.h. (1.88), or driver inattention or distraction (1.74). Except for inattention or distraction, these results exceeded statistical significance. For older drivers the risk of hospitalization increased by 2.5 percent for every one-year increase in age. Older female drivers were 1.30 times more likely to be hospitalized during a crash than were older male drivers. Intersection-driveway crashes had lower risk (0.80).

Summary and Recommendations

Per licensed driver, Iowa older drivers were slightly less likely to be involved in crashes than middle-aged drivers during 2010. We think that older drivers drive fewer miles than middle-aged drivers, and a rate based on miles driven would be higher for older drivers. However, data on miles traveled by age and gender were not available.

While less likely to be involved in crashes, Iowa's older drivers were more likely to be hospitalized if they were in a crash; their rate of hospitalization per licensed driver was 1.4 times that of middle-aged drivers. The medical cost burden, primarily paid through Medicare, was disproportionately higher for older Iowa drivers.

Compared to middle-aged drivers, crashes involving older drivers were more likely to occur during daylight hours, under dry conditions, in urban areas, at intersections and driveways, on roads with lower speed limits, and involve a collision with another vehicle. The driver was more likely to be making a left turn or failed to yield. These results are similar to those reported in other studies (*A Comparison of Maine Crashes Involving Older Drivers Using Codes (Crash Outcome Data Evaluation System) Linked Data*. National Highway Traffic Safety Administration (NHTSA), the National Technical Information Service, Springfield, Virginia 22161, February, 2002. Perceptual problems and difficulty judging and responding to traffic flow are issues for older drivers. These findings suggest that efforts to reduce the total volume of crashes should focus on older driver training on intersection movements in lower speed traffic areas

However, our analysis of the linked outcome results (hospitalization) also provided another view. Crashes resulting in hospitalization were more likely to be on rural, higher speed roads, and often involved a vehicle that ran off the road. Since a large proportion of Iowa roads do not have a paved shoulder or have a gravel shoulder, efforts should be made to add paved shoulders to more Iowa roads.

Older drivers not wearing seat belts were 8.16 times more likely to be hospitalized than were older drivers who were wearing seat belts during a crash. Crashes with animals, alcohol, and speeding, while an important problem in Iowa, were less common in older driver crashes and hospitalizations than for young or middle-aged drivers.

This study provided evidence that older drivers were at increased risk for hospitalization during a crash; this risk increased with age within the older driver group. Miles traveled data needs to be captured for subsets of older drivers to use in future analyses; rates per mile driven may be more significant for older drivers.

A limitation of this study derives from linkage, which does not capture all hospitalizations due to limitations in the underlying data. This means that the numbers of hospitalizations and hospital charges reported here represent minimum counts; therefore, the data are useful for comparative purposes but they do not represent the full burden of injury outcome and cost.

This study underscores the importance of CODES data. Crash locations and driver factors associated with the highest volume crashes were not always associated with the highest proportion of the hospitalizations; these findings illustrate the advantage of incorporating linked medical records, inpatient hospitalizations, in the analysis of motor vehicle crashes.

Table 1
Comparison of CODES Outcome Measures by Age Group
2010 Iowa Licensed Drivers in Passenger Cars and Light Trucks

CODES Measure	Age 14-24	Age 14-24 Rate per 100,000 Drivers	Age 25-64	Age 25-64 Rate per 100,000 Drivers	Age 65 and Over	Age 65 and Over Rate Per 100,000 Drivers
Iowa Licensed Drivers	353,835		1,502,780		420,663	
Iowa Licensed Drivers Involved in Crashes	23,377	6,606.8	46,514	3,095.2	8,130	1932.7
Injury Outcome Measures						
Injured	1,386	391.7	2,670	177.7	561	133.4
Hospitalized	114	32.2	252	16.8	98	23.3
Emergency Dept.	617	174.4	1,100	73.2	239	56.8
Died	43	12.2	103	6.9	49	11.6
with a Head Injury						
Hospitalization Measures						
Linked Hospitalizations	114		252		98	
Total Charges	\$6,656,432.30		\$12,401,112.10		\$4,804,092.30	
Average Charges	\$58,389.80.		\$49,210.80		\$49,021.40	
Median Charges	\$30,599.30		\$32,340.90		\$21,258.90	
Total Patient Days	608		1,348		624	
Average Length Of Stay	5.3		5.3		6.4	
Median Length Of Stay	3		3		4	

Table 1 (continued)
Comparison of CODES Outcome Measures by Age Group
2010 Iowa Licensed Drivers in Passenger Cars and Light Trucks

CODES Measure	Age 65-74	Age 65-74 Rate per 100,000 Drivers	Age 75 and Over	Age 75 and Over Rate Per 100,000 Drivers
Iowa Licensed Drivers	240,439		180,224	
Iowa Licensed Drivers Involved in Crashes	4,364	1,815.0	3,766	2098.6
Injury Outcome Measures				
injured	263	109.4	298	165.3
Hospitalized	44	18.3	54	30.0
Emergency Dept.	108	44.9	131	72.7
Died	23	9.6	26	14.4
Hospitalization Measures				
Linked Hospitalizations	44	18.3	54	30.0
Total Charges	\$2,111,563.70		\$2,692,528.60	
Average Charges	\$47,990.10		\$49,861.60	
Median Charges	\$20,260.40		26,748.20	
Total Patient Days	242		382	
Average Length Of Stay	5.5		7.1	
Median Length Of Stay	3		4	

Table 2
Crash Time and Road Condition by Age Group
2010 Iowa Licensed Drivers in Passenger Cars and Light Trucks

Crash Measure	Age 14-24	Age 14-24 % of Total Involved	Age 25-64	Age 25-64 % of Total Involved	Age 65 and Over	Age 65 and Over % of Total Involved	Hospitalized Age 65 and Over	Hospitalized Age 65 and Over % of Total Involved
Total Drivers Involved	23,377	100.0%	46,514	100.0%	8,130	100.0%	98	100.0%
Day of Week								
Sunday	2,529	10.8%	4,233	9.1%	669	8.2%	4	4.1%
Monday	3,606	15.4%	7,559	16.3%	1,335	16.4%	18	18.4%
Tuesday	2,252	9.6%	6,930	14.9%	1,278	15.7%	21	21.4%
Wednesday	3,424	14.6%	6,852	14.7%	1,322	16.3%	20	20.4%
Thursday	3,121	13.4%	6,529	14.0%	1,165	14.3%	9	9.2%
Friday	4,370	18.7%	8,586	18.5%	1,449	17.8%	17	17.3%
Saturday	3,085	13.2%	5,826	12.5%	912	11.2%	9	9.2%
Month of Crash								
January	2,534	10.8%	5,523	11.9%	741	9.1%	6	6.1%
February	2,726	11.7%	5,086	10.9%	711	8.7%	7	7.1%
March	1,486	6.4%	2,932	6.3%	532	6.5%	8	8.2%
April	1,580	6.8%	2,956	6.4%	642	7.9%	10	10.2%
May	1,785	7.6%	3,318	7.1%	659	8.1%	12	12.2%
June	1,777	7.6%	3,485	7.5%	638	7.8%	4	4.1%
July	1,636	7.0%	3,101	6.7%	602	7.4%	11	11.2%
August	1,730	7.4%	3,406	7.3%	679	8.4%	9	9.2%
September	1,937	8.3%	3,387	7.3%	726	8.9%	7	7.1%
October	1,882	8.1%	3,912	8.4%	703	8.6%	9	9.2%
November	1,985	8.5%	4,261	9.2%	719	8.8%	9	9.2%
December	2,328	10.0%	5,148	11.1%	778	9.6%	6	6.1%
Oct.-March Combined	12,941	55.4%	26,862	57.8%	4,184	51.5%	45	45.9%
April-Sept. Combined	10,445	44.7%	19,653	42.3%	3,946	48.5%	53	54.1%
Light Conditions								
Dawn	287	1.2%	787	1.7%	60	0.7%	0	0.0%
Daylight	15,968	68.3%	33,081	71.1%	6,874	84.6%	87	88.8%
Dusk	645	2.8%	1,164	2.5%	148	1.8%	0	0.0%
Dark	5,928	25.4%	9,298	20.0%	781	9.6%	11	11.2%
Road Surface								
Dry	14,168	60.6%	27,770	59.7%	5,686	69.9%	78	79.6%
Wet, Snow/, Ice, Other	8,559	36.6%	16,229	34.9%	2,132	26.2%	20	20.4%

Table 3
Type of Road Where Crash Occurred by Age Group
2010 Iowa Licensed Drivers in Passenger Cars and Light Trucks

Crash Measure	Age 14-24	Age 14-24 % of Total Involved	Age 25-64	Age 25-64 % of Total Involved	Age 65 and Over	Age 65 and Over % of Total Involved	Hospitalized or Died Age 65 and Over	Hospitalized or Died Age 65 and Over % of Total Involved
Total Drivers Involved	23,377	100.0%	46,514	100.0%	8,130	100.0%	98	100.0%
Urban/Rural								
Urban	16,794	71.8	35,128	75.5	6,487	79.8	37	37.8%
Rural	5,463	23.4	11,116	23.9	1,599	19.7	59	60.2%
Intersection	9,820	42.0%	19,964	42.9%	4,076	50.1%	50	51.0%
Driveway	1,546	6.6%	3,209	6.9%	702	8.6%	4	4.1%
Speed Limit								
<25 MPH	560	2.4%	1,085	2.3%	312	3.8%	8	8.2%
25-35 MPH	8,988	38.4%	16,149	34.7%	3,364	41.4%	16	16.3%
35-45 MPH-	5,412	23.2%	11,199	24.1%	1,832	22.5%	10	10.2%
45-55 MPH	2,122	9.1%	3,939	8.5%	598	7.4%	45	45.9%
55-65 MPH	3,635	15.5%	6,742	14.5%	1,062	13.1%	13	13.3%
65+ MPH	1,565	6.7%	3,513	7.6%	399	4.9%	4	4.1%
Construction Zone								
No	23,063	98.7%	45,777	98.4%	7,967	98.0%	96	98.0%
Yes	314	1.3%	738	1.6%	163	2.0%	2	2.0%

**Table 4
Other Crash and Vehicle Characteristics by Age Group
2010 Iowa Licensed Drivers in Passenger Cars and Light Trucks**

Crash Measure	Age 14-24	Age 14-24 % of Total Involved	Age 25-64	Age 25-64 % of Total Involved	Age 65 and Over	Age 65 and Over % of Total Involved	Hospitalized or Died Age 65 and Over	Hospitalized or Died Age 65 and Over % of Total Involved
Total Drivers Involved	23,377	100.0%	46,514	100.0%	8,130	100.0%	98	100.0%
Hit Animal								
No	22,971	98.3%	44,872	96.5%	7,942	97.7%	98	100.0%
Yes	406	1.7%	1,642	3.5%	188	2.3%	0	0.0%
Ran Off Road	3,696	15.8%	2,445	5.3%	584	7.2%	34	34.7%
No	19,681	84.2%	41,540	89.3%	7,546	92.8%	64	65.3%
Yes	3,696	15.8%	4,974	10.7%	584	7.2%	34	34.7%
Multiple Vehicles Involved								
No	4,588	19.6%	7,576	16.3%	876	10.8%	26	26.5%
Yes	18,123	77.5%	36,684	78.9%	6,953	85.5%	64	65.3%
Vehicle Type								
Passenger	16,385	70.1%	22,444	48.3%	4,857	59.7%	67	68.4%
Van/Light Truck	7,001	29.9%	24,071	51.8%	3,273	40.3%	31	31.6%
# Occupants								
Driver Alone	15,018	64.2%	31,965	68.7%	5,844	71.9%	67	68.4%
2 or More	8,022	34.3%	13,109	28.2%	2,285	28.1%	31	31.6%

Table 5
Driver Characteristics and Behavior by Age Group
2010 Iowa Licensed Drivers in Passenger Cars and Light Trucks

Crash Measure	Age 14-24	Age 14-24 % of Total Involved	Age 25-64	Age 25-64 % of Total Involved	Age 65 and Over	Age 65 and Over % of Total Involved	Hospitalized Age 65 and Over	Hospitalized or Died Age 65 and Over % of Total Involved
Total Drivers Involved	23,377	100.0%	46,514	100.0%	8,130	100.0%	98	100.0%
Gender								
Male	11,982	51.3%	24,373	52.4%	4,486	55.2%	48	49.0%
Female	11,163	47.8%	21,540	46.3%	3,607	44.4%	50	51.0%
Belt Use								
No	348	1.5%	642	1.4%	102	1.3%	12	12.2%
Yes	16,074	68.8%	31,046	66.7%	5,560	68.4%	74	75.5%
Contributing Action								
Failure to Yield	3,298	14.1	4,986	10.7%	1,785	22.0%	22	22.4%
Unsafe Speed	2,147	9.2	2,571	5.5%	205	2.5%	7	7.1%
Other Violation								
Distraction	698	3.2%	795	1.7%	92	1.1%	2	2.0%
Physical Impairment	19	0.1%	106	0.2%	43	0.5%	3	3.1%
Making Left Turn	899	3.8%	1,252	2.7%	423	5.2%	7	7.1%
Driver Condition								
Alcohol	813	3.5%	1,505	3.2%	46	0.6%	1	1.0%
Asleep	217	0.9%	310	0.7%	62	0.8%	2	2.0%
Ill	11	0.0%	75	0.2%	27	0.3%	0	0.0%

Table 6
Results of Logistic Regression Predicting Hospitalization
2010 Iowa Licensed Drivers in Passenger Cars and Light Trucks
Older Drivers Age 65 and Over Only

Crash Variable	Odds Ratio	95% Lower Confidence Limit	95% Upper Confidence Limit	P value
Seat Belt Not Used	8.16	4.20	15.83	P < .001
Age	1.02	1.00	1.05	P < .10
Female	1.30	0.87	1.94	ns.
Rural	6.68	4.41	10.11	P < .001
Speed Limit (per 10 m.p.h. increase)	1.88	0.86	4.17	P < .001
Wet Road	0.59	0.35	1.00	P < .05
Intersection or Driveway	0.80	0.54	1.20	ns
Multiple Vehicle	0.36	0.22	0.56	P < .001
Passenger Car vs. Light Truck	1.44	0.94	2.21	P < .10
Unsafe Speed	2.44	1.06	5.65	P < .05
Driver Distraction	1.74	0.42	7.19	ns
Passengers vs. Driver Alone	0.46	0.26	0.81	P < .01
Daylight	1.43	0.76	2.68	ns