FY2008
Problem Identification Report

Colorado Department of Transportation
Office of Transportation Safety

colorado department of transportation

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The Colorado Department of Transportation, Office of Transportation Safety (OTS) contracted with the University of Colorado to prepare the FY2008 Problem Identification report. Dr. Jeffrey Zax was the Principle Investigator and was assisted by subcontractors Dr. Naci Mocan of Louisiana State University, Jennifer Garner of Garner Insight LLC and Glissen Rhode of Glissen, LLC.

Purpose and Objective

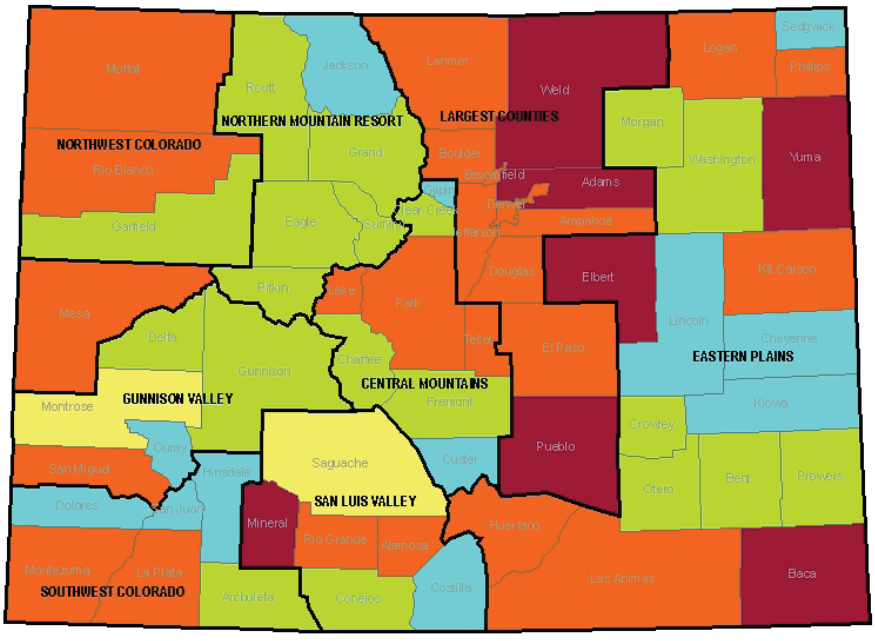
The OTS is tasked with developing behavioral and enforcement-based programs that will improve traffic safety in Colorado by reducing the number and severity of traffic crashes. The OTS's programs target specific high-risk driving behaviors. In order to direct limited resources to the areas of greatest need, the OTS relies on the analysis of crash and other traffic data.

In traditional examinations of driver characteristics and crash involvement, factors such as age of driver, seat belt use and impairment are often examined. In addition to these descriptive statistics (e.g., cross-tabulations), this report includes results of an ordered probit model (for details, see the Technical Appendix) using citation records to predict the likelihood that a driver will be involved in a crash. The ordered probit model allows individual factors that may increase the probability of crash involvement, such as age, citation history, etc. to be examined while controlling for all other factors.

Selected Results

In Colorado in 2004, 667 people died in traffic crashes and another 45,407 were injured. Nearly 100,000 (97,528) crashes were property-damage only (PDO). Using economic cost estimates developed by the National Safety Council, injury and fatal crashes cost Colorado nearly $2.5 billion in 2004. Exhibit 1 shows the distribution of costs across the State and Exhibit 2 on the following page presents the economic loss per capita resulting from injury and fatal crashes for the ten worst Colorado counties.

1. Economic Cost of Injury and Fatal Crashes per 1,000 County Population
Source: 2004 CDOT Crash Data.



2. Top 10 Counties with the Highest Economic Cost per Capita of Injury and Fatal Crashes

Source: 2004 CDOT Crash Data and Economic Cost Estimates from the National Safety Council

Top 10 Counties: *Greatest Cost*

Rank	Counties	Economic Cost
1	Mineral	$1,684,210
▶ 2	Baca	$1,598,630
▶ 3	Elbert	$1,528,630
4	Weld	$1,343,540
5	Pueblo	$1,297,340
▶ 6	Yuma	$1,291,510
7	Adams	$1,236,070
8	Montezuma	$1,208,680
▶ 9	Phillips	$1,130,360
10	La Plata	$1,130,360

▶ Counties in the Eastern Plains Region

Mineral County had the highest per capita cost of injury and fatal crashes among Colorado's 64 counties. Four of the counties with the greatest economic cost are located on the Eastern Plains. Adams County is the most populous county in the top ten, with more than 300,000 residents.

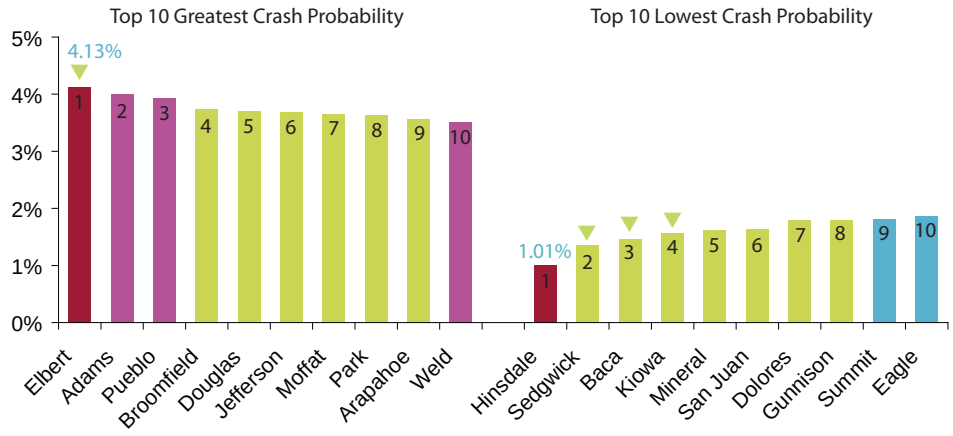
Overall Crash Odds

Exhibit 3 presents the probability that a driver will be in a crash, based on the driver's county of residence. (This data is derived from the ordered probit model.) The table shows how the risk of crashing would change if the same individual moved from one of these counties to another. Drivers from Elbert County have the highest probability of being involved in a crash, controlling for all other factors. Adams and Pueblo counties rank 2nd and 3rd (Exhibit 3).

The counties whose licensed drivers have the lowest probability of crash involvement include both Eastern Plains and mountain communities.

3. Counties Whose Licensed Drivers Have the *Highest* and *Lowest* Probability of Crashing

Source: 2004 CDOT Crash Data and Economic Cost Estimates from the National Safety Council



▶ Counties in the Eastern Plains Region

Young Drivers

In an analysis of the odds that a young driver (under age 21) would be involved in a crash by zip code of residence, all but one of the top ten most dangerous zip codes were in either Pueblo County or Adams County, as shown in Exhibit 4. (Zip codes were limited to the 129 zip codes with at least 1,000 licensed drivers under age 21.)

The zip codes where young drivers had the lowest odds of crashing were spread across the state and included two of the state's largest college towns: Boulder and Fort Collins

Impaired Drivers

After controlling for all other factors, the combination of county of residence and prior DUI records increases the likelihood that a driver is involved in a crash. Exhibit 5 shows the ten worst counties, measured by the increase in odds of a crash when drivers have one or two-to-three DUIs on their citation record. Not surprisingly, Pueblo County leads the pack. Interestingly, Elbert County ranks second.

4. Young Drivers' Odds of Crashing, by Zip Code of Residence

Source: 2004 CDOT Crash Data and Economic Cost Estimates from the National Safety Council

Top 10 *Worst Zip Codes*

Rank	City	Zip	Odds of Crash
▶ 1	Pueblo	81004	7%
▶ 2	Pueblo	81001	7%
3	Lakewood/WR	80214	7%
▶ 4	Commerce City	80022	6%
▶ 5	Pueblo	81007	6%
6	Thornton	80260	6%
7	Thornton	80229	6%
8	Thornton	80223	6%
▶ 9	Pueblo	81006	6%
▶ 10	Pueblo	81005	6%

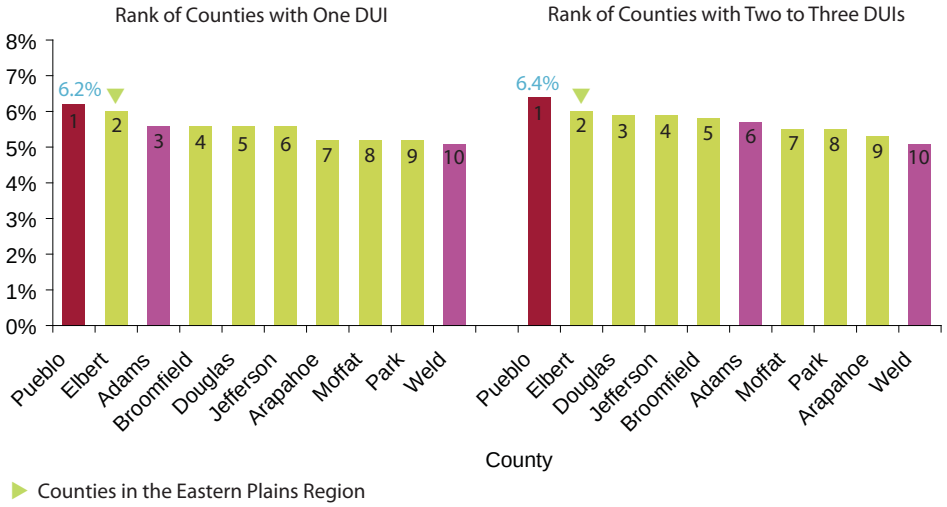
▶ Counties in the Eastern Plains Region

Top 10 *Best Zip Codes*

Rank	City	Zip	Odds of Crash
1	Sterling	80751	4%
2	La Junta	81050	4%
3	Delta	81416	4%
4	Carbondale	81623	4%
5	Cortez	81321	4%
6	Durango	81301	4%
7	Ft. Collins	80525	4%
8	Berthoud	80513	5%
9	Ft. Collins	80525	5%
10	Boulder	80304	5%

5. 10 Worst Counties: Odds of Crash by DUI Records

Source: 2004 CDOT Crash Data and Economic Cost Estimates from the National Safety Council



▶ Counties in the Eastern Plains Region

Occupant Protection

As shown in Exhibit 6, among large counties with seat belt use below the state average (81.1%), Pueblo, Adams and Weld counties are obvious areas for improvement.

Recommendations

Based on the results of the ordered probit model, the analysis of the 2004 crash data and the 2007 Annual Seat Belt Survey, the study team recommends that the Safety and Traffic Engineering Branch consider developing, supporting or expanding traffic safety programs in the following communities:

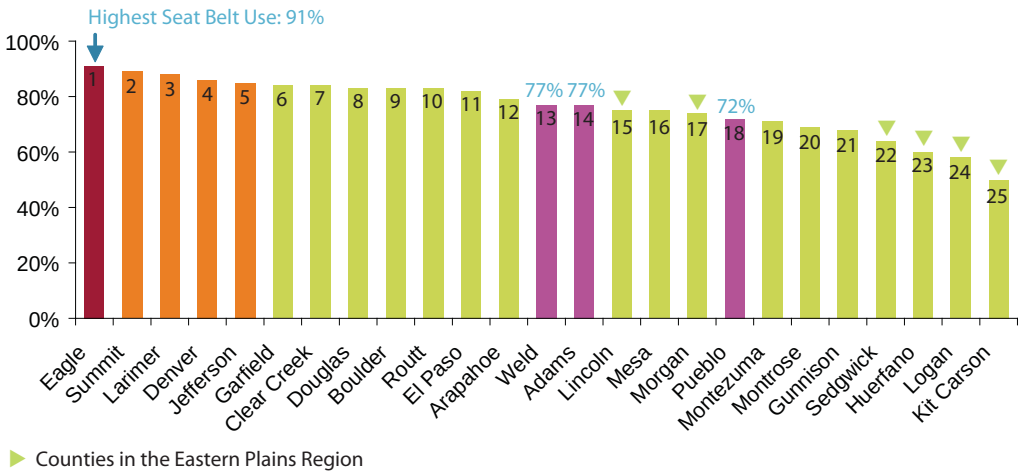
- Adams County
- Pueblo County
- Elbert County
- Yuma County

Adams County. Adams County needs a comprehensive traffic safety program that includes components addressing impaired driving, occupant protection and young drivers. It is imperative that the program not solely address young drivers, but adults as well. The program should include community-based social marketing efforts and education as well as law enforcement focused on seat belts and impaired driving. It is important to note that more information is needed to refine the target audiences for programs in Adams County. For example, if local seat belt surveys could be conducted, the program partners would have a better sense of the demographics of Adams County drivers who do not use seat belts (e.g., age, race/ethnicity, vehicle type) as well as the parts of the County where drivers are least likely to use seat belts (e.g., urban vs. rural).

Elbert County. Elbert County's biggest problem, according to the data, is that Elbert County licensed drivers have the highest odds of being involved in a crash, compared to all other counties. Elbert also has a disproportionately high cost per capita of injury and fatal crashes. The model estimates that Elbert County drivers with one DUI record are 6% more likely to be in-

6. Observed Seat Belt Use - 25 County Ranking

Source: Colorado State University Annual Seat Belt Survey



volved in a crash – the second highest rate among all 64 counties. Low seat belt use is assumed because Elbert County is located on the Eastern Plains, which traditionally has low seat belt use. If a comprehensive program is initiated in Elbert County, an observational seat belt survey should be a component to both assess overall seat belt use and set a baseline for future reference.

Pueblo County. Pueblo County needs a comprehensive traffic safety program that addresses adult impaired drivers, occupant protection and young drivers. It is important that young driver programs include all drivers age 21 and younger, not just those still in high school. Community-based programs should reach out to community colleges and large employers of younger workers. It is also important that adults be included in the impaired driving and occupant protection efforts and that both community outreach as well as enforcement are components of the program. More information is needed to refine the target audiences for programs. For example, what types of Pueblo residents were not using their seat belts when the statewide survey was conducted?

Yuma County. Among Eastern Plains counties, Yuma County has the third highest economic cost of injury and fatal crashes per capita. Because Yuma County has one of the larger driving age populations on the Eastern Plains, Yuma County may be a good location to pilot a community-based occupant protection program tailored to the values and experiences of Eastern Plains communities. If the program is successful, it should be expanded to the other Eastern Plains communities. A seat belt survey should be conducted prior to investing significantly in a seat belt program to confirm the strong suspicion that seat belt use is a problem in Yuma County.

Data Needed

Occupant Protection Data. The analyses of occupant protection, in particular, are limited by the accuracy of available data. The Annual Seat Belt Survey conducted by Colorado State University represents the best and most reliable point-in-time data on seat belt use statewide. In FY2007, the survey was expanded to include additional observations of seat belt use by racial and ethnic minorities. The study team would recommend that, if dollars are available, the survey include a supplemental component featuring observations in more than 25 counties, particularly on the Eastern Plains where seat belt use traditionally lags the Front Range. It would also be valuable for the data collected on children and young adults to be reported on the county-level, in addition to the currently available statewide estimate.

Although occupant protection data collected as part of fatal and severe crash investigations is more accurate, the very small number of such crashes, particularly in small counties, makes the seat belt data impossible to accurately interpret. Basing a small county's estimates of seat belt use, for example, on the small number of severe injury and fatal crashes would be invalid.

Original Citation File. The ordered probit model estimated the probability of crashing using a wide array of data from the Motor Vehicle Division. Chief among these databases is the adjudicated citation file. If possible to obtain, the original citation file in addition to adjudicated citations would provide a rich dataset and would allow the study team to vastly expand its analyses.

Current Crash Data. Obviously, more current crash data is needed for the analyses to have improved relevance for program development and selection.

Recommended Analytical Focus for FY2009

The study team recommends that future Problem Identification reports continue to emphasize place-based analyses and expand those analyses whenever possible. With sufficient time for data collection, cleaning and analysis, we believe that the model can be expanded to include demographic data on the census tract level, as well as sub-analyses such as looking at the impact of recent citations or address changes by county.

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Purpose and Objective

The OTS is tasked with developing behavioral and enforcement-based programs that will improve traffic safety in Colorado by reducing the number and severity of traffic crashes. The OTS's programs target specific high-risk driving behaviors, such as impaired driving or drivers who do not use occupant protection, and high-risk populations, such as teenagers and motorcycle riders. In order to direct limited resources to the areas of greatest need, the OTS relies on the analysis of crash and other traffic data. Historically, the primary data sources used to supply the OTS with this critical information is the database of Colorado crash records for a particular year, the data included in the Fatality Analysis Reporting System (FARS) and the results of Colorado's annual seat belt survey. For the FY2008 Problem Identification, the Colorado Department of Revenue, Motor Vehicles Division's complete (adjudicated) citation database and several other modules (e.g., the DUI file in which officer's report data, any request for a hearing, and BAC test results) were merged with the 2004 crash database (the most recent year available).

Because the OTS will use the analytical results to develop location-based programs, most of the analyses focus on the city or county of residence of high-risk drivers.

New Analytical Approach

Past Problem Identification projects have attempted to understand the crash experiences of Colorado drivers by constructing multiple cross-tabulations. These cross-tabulations are convenient for presentational purposes. However, they are unavoidably reductionist. Each focuses on a small number of crash and driver characteristics. The exclusion of other characteristics that may also be important could lead to false inferences from any or all of such cross-tabulations.

The 2008 Problem Identification project presents a new way of interpreting the annual crash experiences of Colorado drivers. This project takes a more comprehensive approach to the analysis of crash experiences. It characterizes each Colorado resident with a Colorado driv-

er's license based on all available information about that driver as of December 31, 2003. It then imputes the probability that each driver will be involved in a property-damage-only (PDO), injury or fatal crash during the year. These imputed probabilities can then be aggregated to identify demographic groups or geographic areas which contain high concentrations of at-risk drivers.

The foundation for these imputations is the data held by the Motor Vehicle Division in its various files regarding drivers licenses, traffic violations and sanctions. These files yield measures of age, sex, height, weight, county of residence, residential mobility, numbers and points from past adjudicated citations, duration since last adjudicated citation, numbers of DUI records, BAC test results, and test refusals. These measures, matched with actual 2004 crash experiences in an ordered probit analysis, yield estimates of how each measured characteristic affects the probability of experiencing a crash of any given severity.

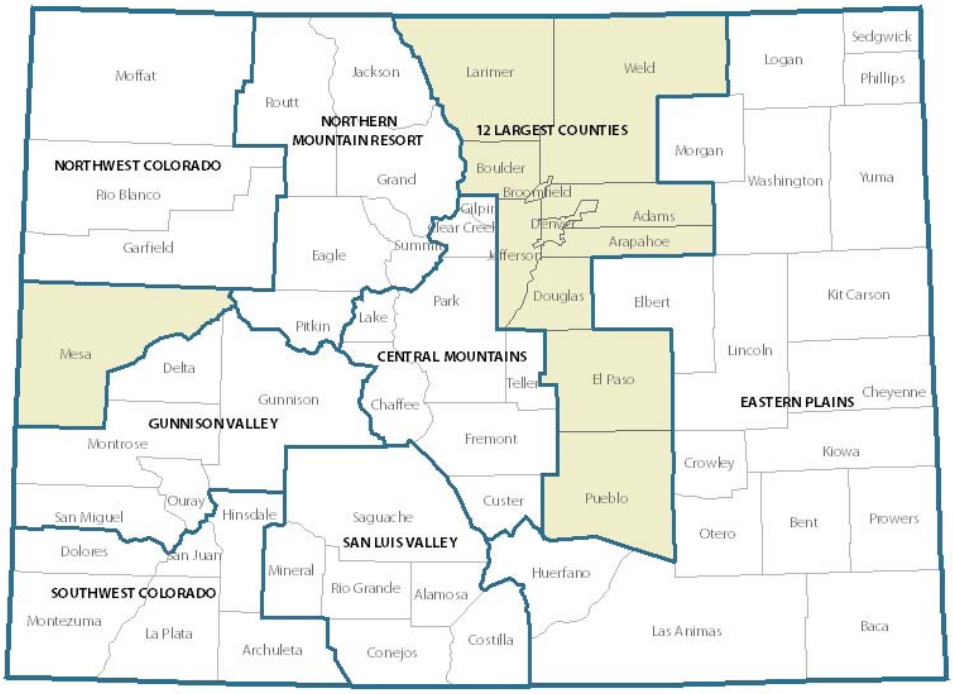
Colorado Regions

In some cases, regional analyses are more appropriate than examining a single county or city. The following map details the counties that comprise the regions detailed elsewhere in the report.

Acknowledgements

The study team would like to acknowledge the leadership of Gabriela Vidal and Stephanie Olson and the assistance of Glenn Davis, Carol Gould, Ilana Erez, Leslie Chase, Robin Rocke, Heather Halpape, Rahim Mirandi, Dwayne Wilkenson and Robert Weltzer in developing the geographic focus of this report.

1. | **Colorado Regions**
Source: Colorado Department of Transportation



In Colorado in 2004, 667 people died in traffic crashes and another 45,407 were injured. Nearly 100,000 (97,528) crashes were property-damage only (PDO). Using economic cost estimates developed by the National Safety Council, injury and fatal crashes cost Colorado nearly $2.5 billion in 2004.

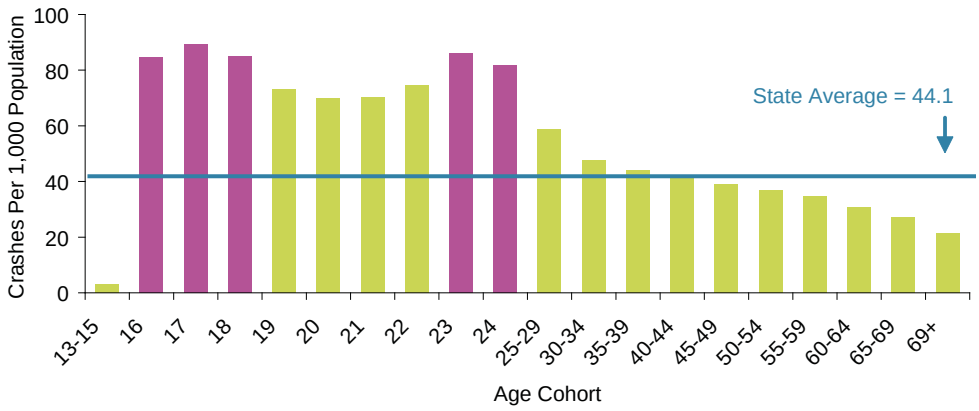
CDOT's Office of Transportation Safety (OTS) educates and works to reduce the number and severity of traffic crashes through a combination of engineering, law enforcement, education and emergency services programs across the state. The OTS also works with the CDOT engineering staff to develop solutions to highway safety problems. Learning more about those drivers who are more likely to be involved as a driver in a crash helps the OTS staff develop more effective programs. This section provides an overview of the driver characteristics associated with increased risk of crash involvement.

In traditional examinations of driver characteristics and crash involvement, factors such as age of driver, seat belt use and impairment are often examined. In addition to these descriptive statistics (e.g., cross-tabulations), this report includes results of an ordered probit model (for details, see the Technical Appendix). The ordered probit model allows individual factors that may increase the probability of crash involvement, such as age, citation history, etc. to be examined while controlling for all other factors. Both methods – descriptive statistics and ordered probit model – are included in this section.

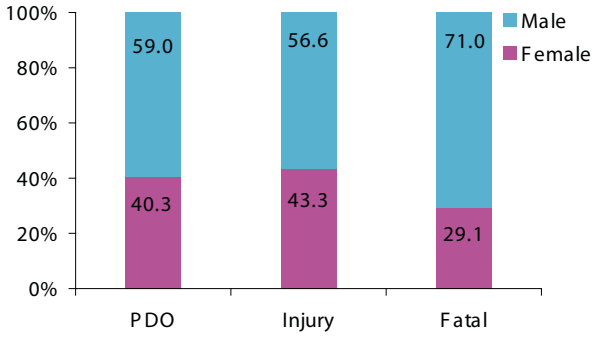
Driver Age and Gender

Age of Driver. For many reasons, it's not surprising that younger drivers are more likely to be involved in crashes than older drivers. The youngest drivers tend to have the least driving experience. Without controlling for other factors, 17 year-old drivers have the highest per capita crash involvement, compared to all other age cohorts, as demonstrated in Exhibit 1.

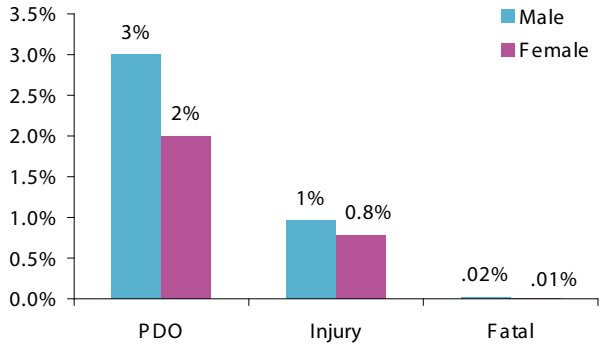
1. Age of Drivers in all Crashes Per 1,000 Capita
Source: 2004 CDOT Crash Data



2. **Gender of Driver by Severity of Crash**
Source: 2004 CDOT Crash Data



3. **Probability of Crashing: Role of Gender**
Source: 2004 Crash and Citation Model

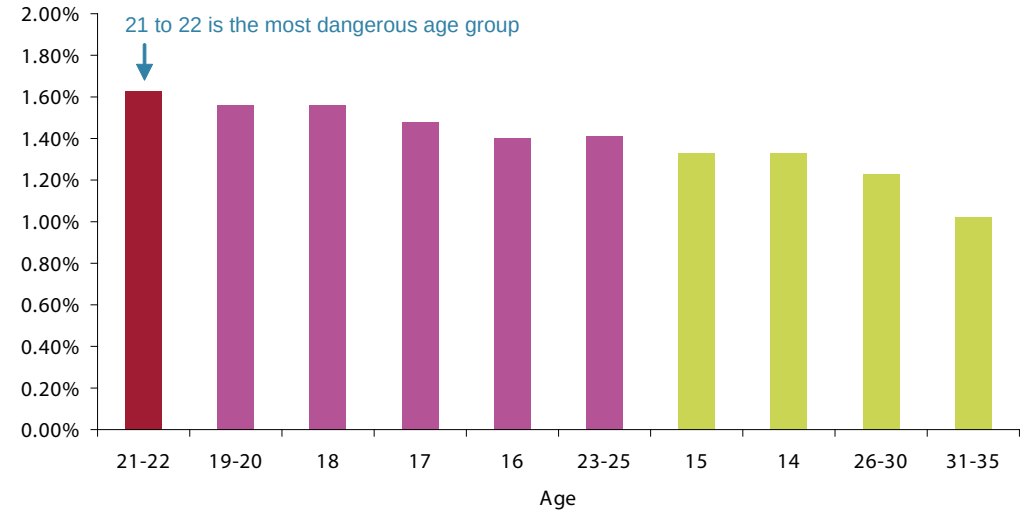


Controlling for all other factors (e.g., place of residence, citation history, height, weight, etc.), younger drivers continue to have a higher probability of crashing than older age cohorts. Exhibit 4 presents the ten age cohorts whose odds of crashing increased the most due to their age. Although teenagers have the highest crash rate per capita, drivers in their early 20s also have disproportionately high crash rates. This is also borne out in the probit analysis, where 21-22 year old drivers have the highest increase in odds of crashing when age is the variable of interest.

Gender of Driver. Historically, in static (cross-tabulation) analyses of gender and traffic crashes, men comprise a greater proportion crash drivers than women, and the difference is greatest in fatal crashes. See Exhibit 2.

After controlling for all other factors, gender still plays a role in the odds of crashing, although the effect is smaller than what might be expected. See Exhibit 3.

4. **The Ten Most Dangerous Ages**
Source: 2004 Crash and Citation Model



Impaired Drivers

In 2004, more than 8,000 drivers involved in crashes were suspected of impairment by alcohol, drugs or both. Drivers between the ages of 21 and 24 were more than twice as likely to be impaired than the average driver statewide.

Drivers with a history of DUI have increased odds of being involved in a crash compared to those with no history of DUI (Exhibit 5). For example, the overall odds of being involved in a PDO crash is 2.25% for drivers with no history of DUI. This increases to 3.41% if a driver has one prior DUI record on their adjudicated citation history. As the number of prior DUI records exceeds more than two, the odds of PDO crash involvement decrease from the high reached at one DUI, but they never fall below the non-DUI odds. This decrease from the high of 3.55% may indicate a deterrence effect resulting from DUI enforcement and the consequences of DUI. See Exhibit 5.

If a driver has a maximum recorded BAC of 0.10 to 0.20 on their record, the odds of being involved in an injury crash are twice that of a driver with no record of a BAC test on their citation history. As the maximum recorded BAC on record goes up, so do the odds of the driver being involved in PDO, injury and fatal crashes. See Exhibit 6.

Occupant Protection

"Seat belts save lives" is more than a slogan. Properly used seat belt and child passenger safety devices can be the difference between a PDO crash and an injury crash. In its work to reduce injury and fatal crashes, the OTS supports community-based and enforcement projects to increase seat belt use. The following exhibits character-

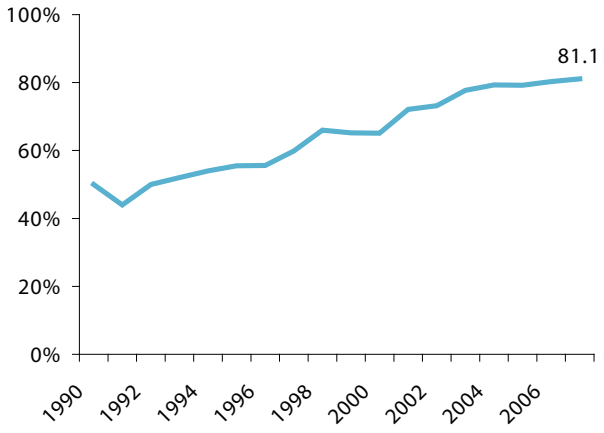
5. Probability of Crashing: Role of Prior Number of DUI Records
Source: 2004 Crash and Citation Model

Number of DUI Records	Odds of PDO Crash	Odds of Injury Crash	Odds of Fatal Crash
Zero	2.25%	0.83%	0.01%
1	3.41%	1.41%	0.03%
2	**3.55%**	**1.48%**	**0.03%**
3	3.46%	1.43%	0.03%
4	3.31%	1.35%	0.03%
5	3.19%	1.28%	0.02%
6	3.03%	1.19%	0.02%
7	2.92%	1.13%	0.02%
8	2.90%	1.13%	0.02%
9	2.56%	0.94%	0.01%
10	2.30%	0.81%	0.01%

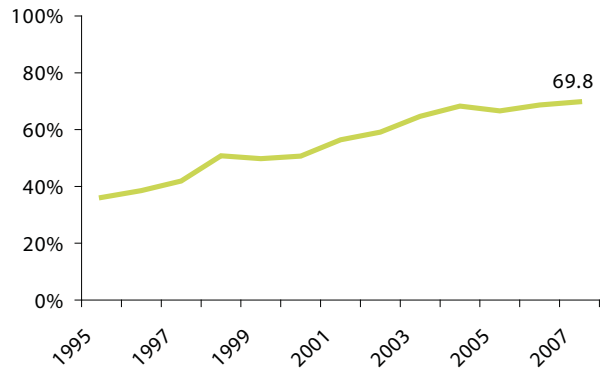
6. Probability of Crashing: Role of Maximum Recorded BAC Level on the Driver's Record
Source: 2004 Crash and Citation Model

Maximum Recorded BAC	Odds of a Crash		
	PDO	Injury	Fatal
No Test	2.27%	0.84%	0.01%
0.0 to 0.10	3.38%	1.40%	0.03%
0.10 to 0.20	**4.13%**	**1.77%**	**0.04%**
0.20 to 0.30	**4.19%**	**1.81%**	**0.04%**
0.30 to 0.40	4.55%	2.01%	0.04%
0.40 to 0.50	5.23%	2.50%	0.07%
0.50 to 0.60	5.43%	2.46%	0.05%

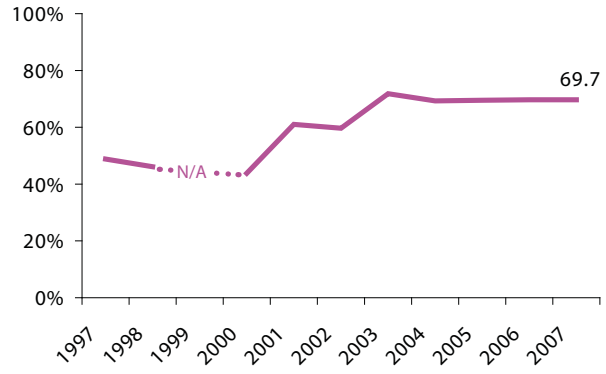
7. Statewide Overall Seat Belt Usage
Source: Colorado State University Annual Seat Belt Survey



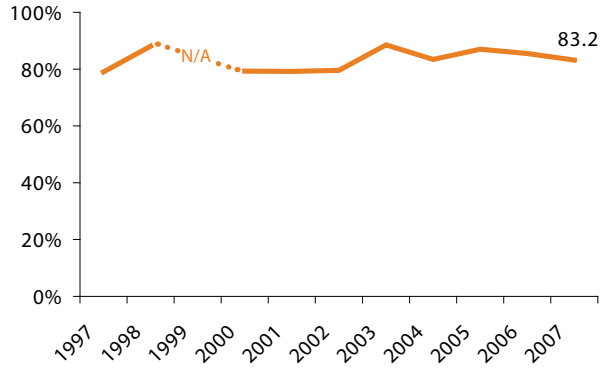
8. **Use of Seat Belts by Front Seat Occupants of Light Trucks**
Source: Colorado State University Annual Seat Belt Survey



9. **Use of Seat Belts by Juveniles Ages 5 to 15**
Source: Colorado State University Annual Seat Belt Survey



10. **Use of Car Seat/Booster Seats by Youngest Children**
Source: Colorado State University Annual Seat Belt Survey



ize seat belt use statewide. County level analyses are included in Section III of this report.

The most reliable source of occupant protection data is the Office of Transportation Safety-funded Annual Seat Belt Survey conducted by the Institute of Transportation Management at Colorado State University.

In 2007, observed seat belt use in Colorado was 81.1%, as shown in Exhibit 7 on the previous page. Front seat occupants of passenger cars and drivers in the Front Range were more likely to use seat belts than other groups observed.

Front seat occupants of light trucks (pick-up trucks) are much less likely than all drivers to use seat belts. Given the high proportion of light trucks in use in Colorado's rural Eastern Plains, the light truck seat belt use rate may be an additional measure of rural seat belt use. See Exhibit 8.

Exhibit 9 details observed seat belt use by juveniles ages 5 to 15. Only 70% of juveniles were properly restrained. Juvenile seat belt use has been in a near-plateau since 2003. (The survey was not conducted in 1999.)

Exhibit 10 details trends in observed car seat/booster seat use by the youngest children. Although use of child passenger safety devices is greater than any other occupant protection devices, the goal for the youngest children is 100% compliance. Towards that end, there is much work to be done.

Other Factors

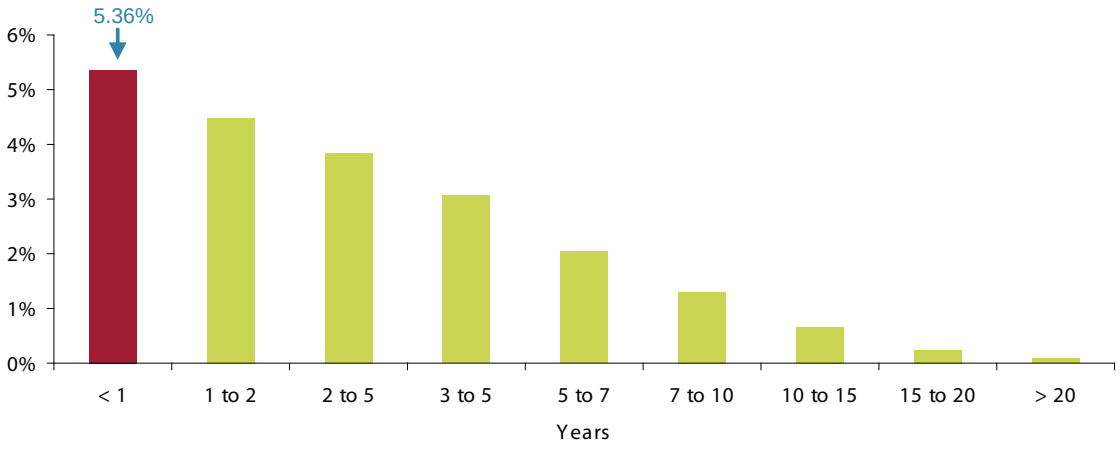
Additional factors beyond those traditionally explored were used to estimate the probability of crashing. These included

many variables found in the adjudicated citation file. Two of those factors, length of time at current residence and length of time since last driving citation were associated with increased odds of crashing. (In future problem identification analyses, the study team recommends attempting to examine these two measures by county.)

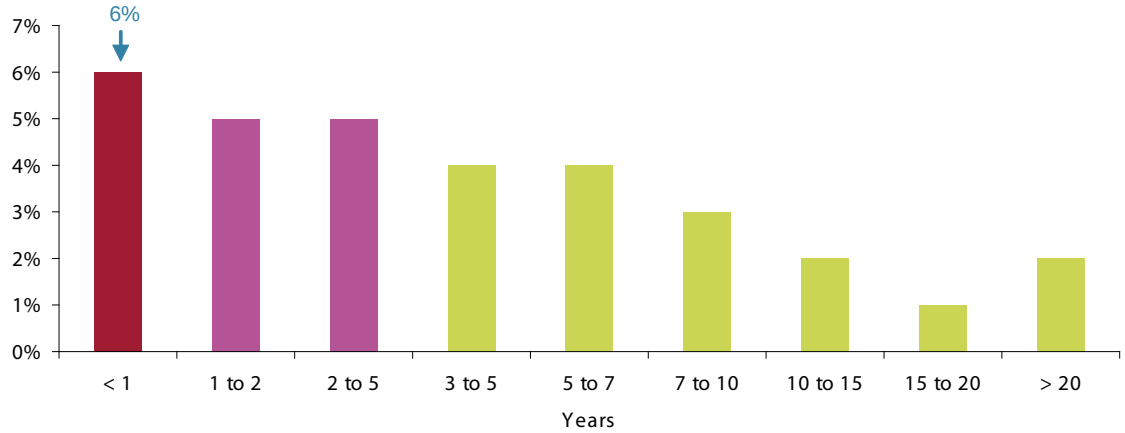
Drivers who reported a change of address to the MVD in the past year were 5% more likely to be involved in a crash. As the years since a change of address increase, the odds of crashing associated with moving decrease. This suggests that when drivers are unfamiliar with an area, they have an increased risk of crash involvement. See Exhibit 11.

Drivers who had a citation in the past year are 6% more likely to be involved in a crash, as shown in Exhibit 12.

11. Probability of Crashing: Years Since Last Address Change
Source: 2004 Crash and Citation Model



12. Probability of Crashing: Years Since Last Driving Citation
Source: 2004 Crash and Citation Model



This section examines high risk drivers by their county of residence.

Economic Cost of Crashes

In 2004, the estimated economic cost of injury and fatal crashes to Colorado was nearly $2.5 billion dollars. The cost of crashes per capita varies among Colorado's counties. Exhibit 1 shows how the costs per capita of injury and fatal crashes are distributed across the state.

Exhibit 2 details the ten counties with the highest economic cost per capita of injury and fatal crashes. Four of the ten counties with the highest economic cost of injury and fatal crashes per capita were on the Eastern Plains. Adams, Weld and Pueblo counties were among the top ten counties with the highest per capita cost.

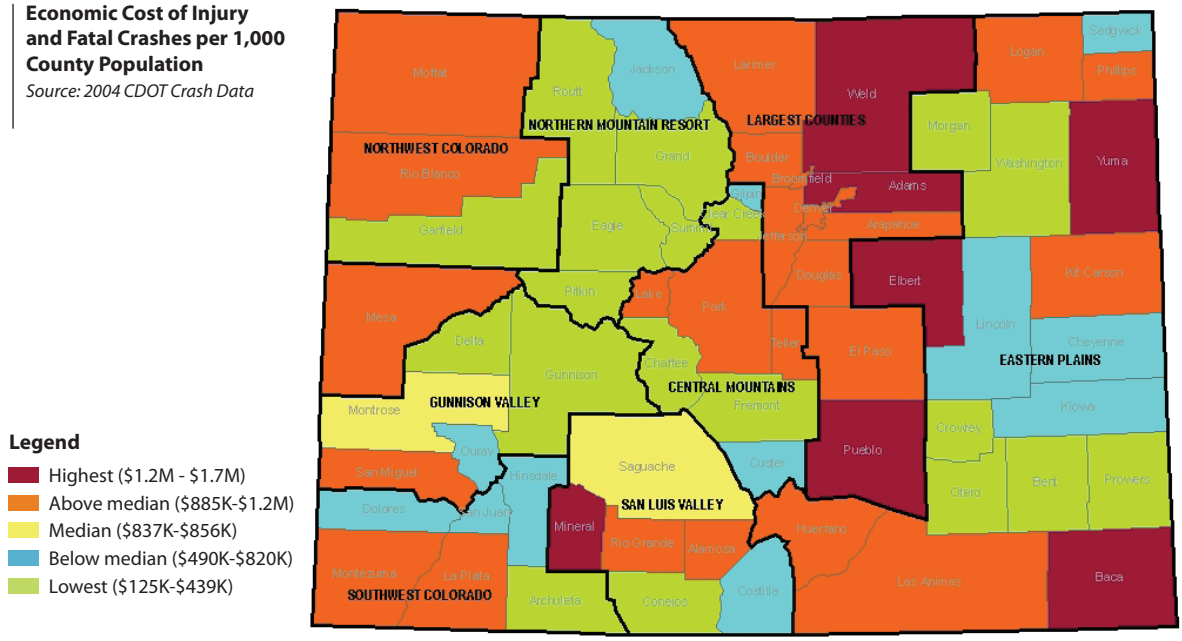
2. Top 10 Counties with the Highest Economic Cost per Capita of Injury and Fatal Crashes
Source: 2004 CDOT Crash Data and Economic Cost Estimates from the National Safety Council

Top 10 Counties: *Greatest Cost*

Rank	Counties	Economic Cost
1	Mineral	$1,684,210
▶ 2	Baca	$1,598,630
▶ 3	Elbert	$1,528,630
4	Weld	$1,343,540
5	Pueblo	$1,297,340
▶ 6	Yuma	$1,291,510
7	Adams	$1,236,070
8	Montezuma	$1,208,680
▶ 9	Phillips	$1,130,360
10	La Plata	$1,130,360

▶ Counties in the Eastern Plains Region

1. Economic Cost of Injury and Fatal Crashes per 1,000 County Population
Source: 2004 CDOT Crash Data



Legend
- Highest ($1.2M - $1.7M)
- Above median ($885K-$1.2M)
- Median ($837K-$856K)
- Below median ($490K-$820K)
- Lowest ($125K-$439K)

3. Counties with the Lowest Economic Cost per Capita of Injury and Fatal Crashes

Source: 2004 CDOT Crash Data and Economic Cost Estimates from the National Safety Council

Top 10 Counties: *Lowest Cost*

Rank	Counties	Economic Cost
1	Jackson	$124,850
▶ 2	Kiowa	$175,450
▶ 3	Lincoln	$221,100
4	Gilpin	$226,600
5	Hinsdale	$239,800
6	Dolores	$226,200
7	Ouray	$268,400
8	Custer	$292,600
▶ 9	Cheyenne	$310,750
10	Costilla	$310,150

▶ Counties in the Eastern Plains Region

Exhibit 3 shows the Colorado counties that had the lowest cost per capita of injury and fatal crashes. These counties had some of the smallest number of injury and fatal crashes in 2004. Three of these counties are on the eastern plains.

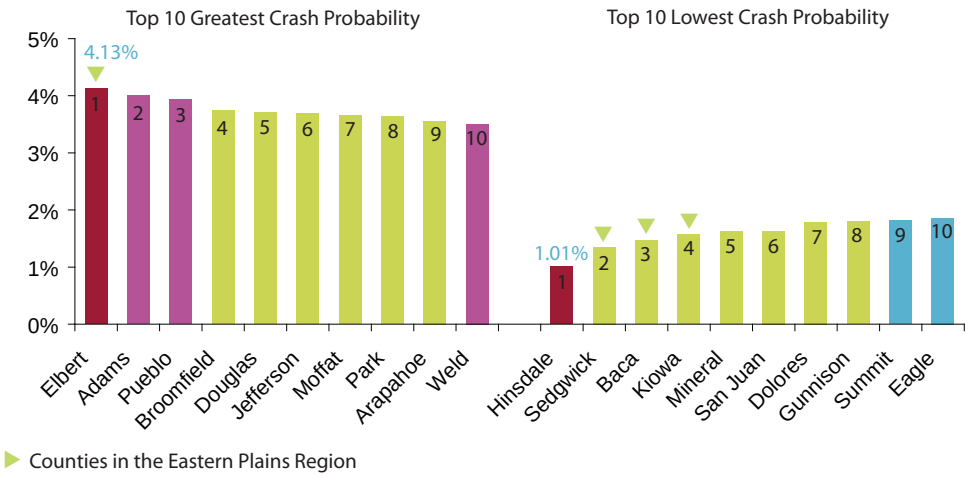
Odds of Crash Involvement

Exhibit 4 presents the probability that a driver will be in a crash, based on the driver's county of residence. (This data is derived from the ordered probit model.) The table shows how the risk of crashing would change if the same individual moved from one of these counties to another. Drivers from Elbert County have the highest probability of being involved in a crash, controlling for all other factors. Adams and Pueblo counties rank 2nd and 3rd.

The counties whose licensed drivers have the lowest probability of crash involvement include both Eastern Plains and mountain communities. Three of the five counties whose residents have the least odds of crashing are on the Eastern Plains.

4. Counties Whose Licensed Drivers Have the *Highest* and *Lowest* Probability of Crashing

Source: 2004 CDOT Crash Data and Economic Cost Estimates from the National Safety Council



▶ Counties in the Eastern Plains Region

Young Drivers

In an analysis of the odds that a young driver (under age 21) would be involved in a crash by zip code of residence, all but one of the top ten most dangerous zip codes were in either Pueblo County or Adams County. (Zip codes were limited to the 129 zip codes with at least 1,000 licensed drivers under age 21.) See Exhibit 5. For detailed information about each zip code, see www.americanfactfinder.com. Something related to living in one of these zip codes, or having one of these zip codes as their last registered address, makes these drivers more dangerous.

It is the case that some drivers under age 21 move away from their home zip code to attend college, and these drivers do not necessarily change their driver registration. Particularly in Adams and Pueblo counties, the proportion of young drivers who go to college may be less than 20%, based on the proportion of adults in each county with a four year degree.

It is also important to note that on most measures, Colorado's two major college communities, Boulder and Ft. Collins, are less dangerous than other communities. For example, Boulder had the lowest proportion of drivers involved in serious crashes who were impaired. Out of 25 counties surveyed, Larimer County had the 3rd highest seat belt use and Boulder County ranked 9th. Larimer County has the 25th highest economic cost of injury and fatal crashes per capita and Boulder County ranks 28th.

The zip codes where young drivers had the lowest odds of crashing were spread across the state and included two of the state's largest college towns: Boulder and Fort Collins. See Exhibit 5.

5. Young Drivers' Odds of Crashing, by Zip Code of Residence

Source: 2004 CDOT Crash Data and Economic Cost Estimates from the National Safety Council

Top 10 *Worst Zip Codes*

Rank	City	Zip	Odds of Crash
▶ 1	Pueblo	81004	7%
▶ 2	Pueblo	81001	7%
3	Lakewood/WR	80214	7%
▶ 4	Commerce City	80022	6%
▶ 5	Pueblo	81007	6%
6	Thornton	80260	6%
7	Thornton	80229	6%
8	Thornton	80223	6%
▶ 9	Pueblo	81006	6%
▶ 10	Pueblo	81005	6%

▶ Counties in the Eastern Plains Region

Top 10 *Best Zip Codes*

Rank	City	Zip	Odds of Crash
1	Sterling	80751	4%
2	La Junta	81050	4%
3	Delta	81416	4%
4	Carbondale	81623	4%
5	Cortez	81321	4%
6	Durango	81301	4%
7	Ft. Collins	80525	4%
8	Berthoud	80513	5%
9	Ft. Collins	80525	5%
10	Boulder	80304	5%

6. Percentage of Licensed Drivers Under Age 21 with DUI Records – Worst Counties

Source: 2004 CDOT Crash Data and Economic Cost Estimates from the National Safety Council

Rank	City	Odds of Crash
1	Conejos	12%
2	Alamosa	10%
▶ 3	Prowers	10%
4	Rio Grande	10%
5	Jackson	10%
6	Lake	10%
7	Costilla	9%
8	Saguache	9%
▶ 9	Bent	9%
▶ 10	Otero	8%
11	Montezuma	8%

▶ Counties in the Eastern Plains Region

7. **Percent of Injury/Fatal Crash Drivers Who Were Impaired**
Source: 2004 Crash Data

5 Worst **Large Cities**

Rank	Cities	County	% of Impaired Injury Crash Drivers
1	Littleton	Jefferson/ Arapahoe	10%
2	Northglenn	Adams	7%
3	Greeley	Weld	7%
4	Arvada	Jefferson	7%
5	Pueblo	Pueblo	6%

8. **Percent of Injury/Fatal Crash Drivers Who Were Impaired**
Source: 2004 Crash Data

5 Best **Large Cities**

Rank	Cities	% of Impaired Injury Crash Drivers
1	Boulder	2%
2	Parker	3%
3	Longmont	3%
4	Centennial	3%
5	Grand Junction	3%

Impaired Drivers

After controlling for all other factors, the combination of county of residence and prior DUI records increases the likelihood that a driver is involved in a crash. Exhibit 6 on the previous page shows the ten worst counties, measured by the increase in odds of a crash when drivers have one or two-to-three DUIs on their citation record. Not surprisingly, Pueblo County leads the pack. Interestingly, Elbert County ranks second.

Among Colorado's 24 largest cities, there is significant variation in the incidence of impaired drivers involved in serious crashes in the city. Exhibit 7 shows the cities that had the highest incidence of impaired drivers in serious crashes in 2004. Cities from Adams, Weld, Pueblo and Jefferson/Arapahoe counties comprised the five worst cities on this measure.

The cities with the lowest rate of impaired drivers in serious crashes are shown in Exhibit 8. These cities are found in Boulder, Douglas and Mesa counties.

9. **10 Worst Counties: Odds of Crash by DUI Records**
Source: 2004 CDOT Crash Data and Economic Cost Estimates from the National Safety Council

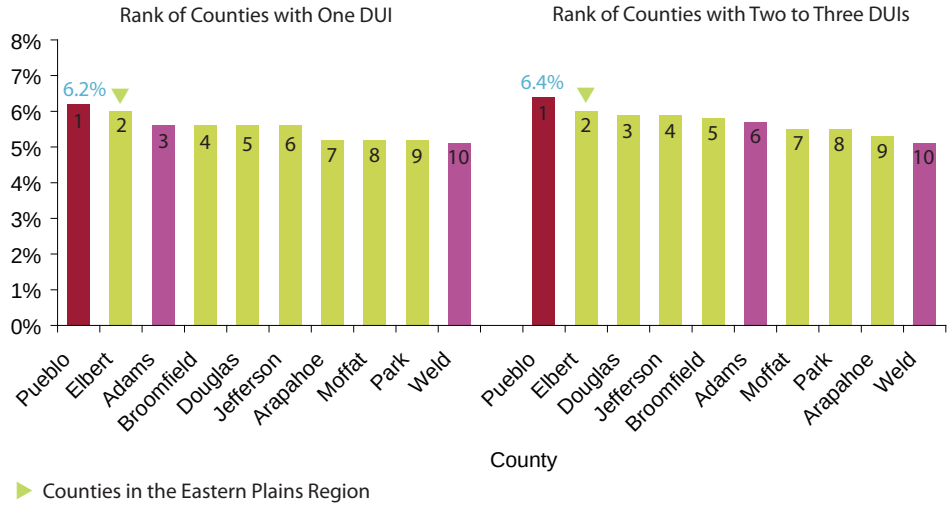


Exhibit 10 presents the proportion of licensed drivers age 21 and older who have a prior DUI record on their citation file, by county.

Occupant Protection

As discussed in Section II, the most reliable data available to analyze Colorado drivers' use of occupant safety devices is the statewide Annual Seat Belt Survey. This study's strict methodology relies on a complex sampling scheme to derive estimates of regional and statewide seat belt use. Although observational surveys are not conducted in all of Colorado's 64 counties, we do have results that are considered best available estimates of seat belt use in 25 counties from across the state. Among the counties included in the study, Eagle County had the highest observed seat belt use.

As shown in Exhibit 11, among large counties with seat belt use below the state average (81.1%), Pueblo, Adams and Weld counties are obvious areas for improvement. Adams County is the fifth most populous county in

10. Percent of Licensed Drivers Age 21 and Older with a Prior DUI Record, by County

Source: 2004 Citation Data

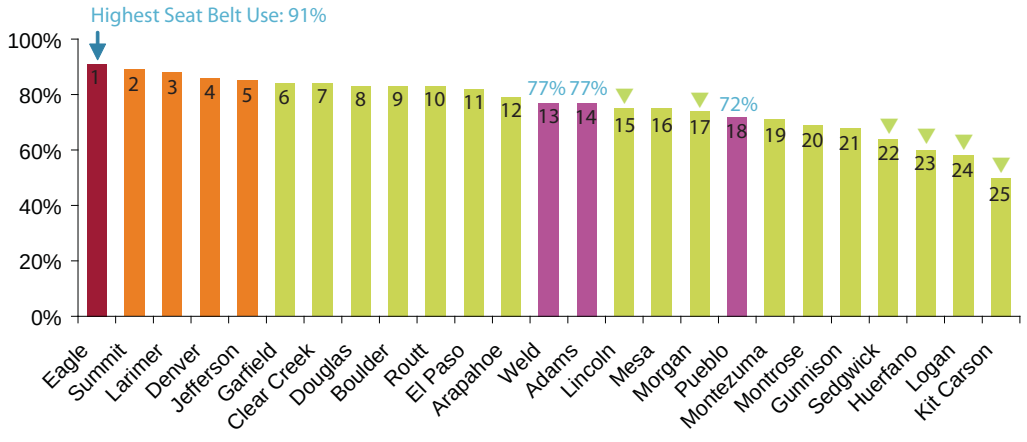
***25 Worst* Counties**

Rank	Counties	1 or More DUIs
1	Alamosa	11%
2	Conejos	11%
3	Rio Grande	11%
4	Lake	11%
5	Clear Creek	11%
6	Prowers	10%
▶ 7	Otero	10%
▶ 8	Las Animas	10%
9	Pueblo	10%
10	Costilla	10%
▶ 11	Crowley	10%
12	Garfield	10%
▶ 13	Morgan	10%
▶ 14	Huerfano	10%
15	Adams	10%
▶ 16	Bent	9%
17	Montezuma	9%
18	Routt	9%
19	Saguache	9%
20	Weld	9%
21	Summit	9%
22	La Plata	9%
23	Eagle	9%

▶ Counties in the Eastern Plains Region

11. Observed Seat Belt Use - 25 County Ranking

Source: Colorado State University Annual Seat Belt Survey



▶ Counties in the Eastern Plains Region

12. Percent of Severe Crash Drivers NOT Using Seat Belts, Regions and Large Counties
Source: 2004 CDOT Crash Data

Rank	Counties and Regions	Percent
1	San Luis Valley	36%
2	Northwest CO	35%
▶ 3	Eastern Plains	34%
4	Southwest CO	30%
5	Pueblo	27%
6	Weld	26%
7	Central Mountains	26%
8	Adams	24%
9	Northern Mtn Resort	23%
10	Larimer	23%
11	El Paso	23%
12	Gunnison Valley	23%
13	Douglas	19%
14	Jefferson	18%
15	Denver	16%
16	Boulder	16%
17	Mesa	15%
18	Arapahoe	12%
19	Broomfield	0%

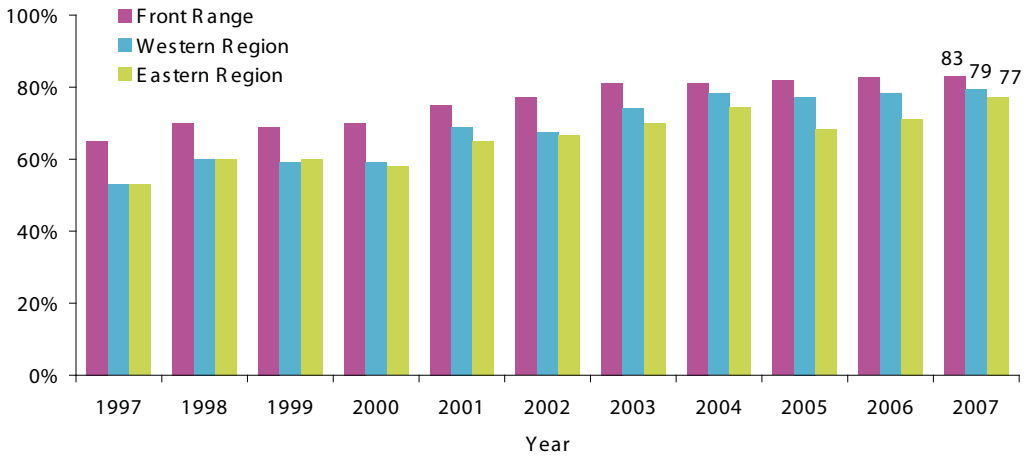
▶ Counties in the Eastern Plains Region

Colorado, with an estimated 303,000 residents. Eastern Plains counties comprise the bottom of the barrel, with the lowest observed seat belt use rates among all the counties surveyed.

In addition to the statistically representative and valid Annual Seat Belt Survey, limited data on passenger occupant protection use is found in the statewide crash database. However, this data is particularly unreliable for less severe crashes, as drivers may lie to officers about whether or not they were using a seat belt at the time of the crash. Therefore, less severe crashes are excluded from descriptive occupant protection analyses included in this section. Rather, only those crashes where there was an evident, incapacitating injury or fatality are included. 36% of the drivers in severe crashes in the San Luis Valley were unbelted. See Exhibit 12.

The Eastern Plains has historically lagged behind the Front Range and Western Region of the state in observed seat belt use. See Exhibit 13.

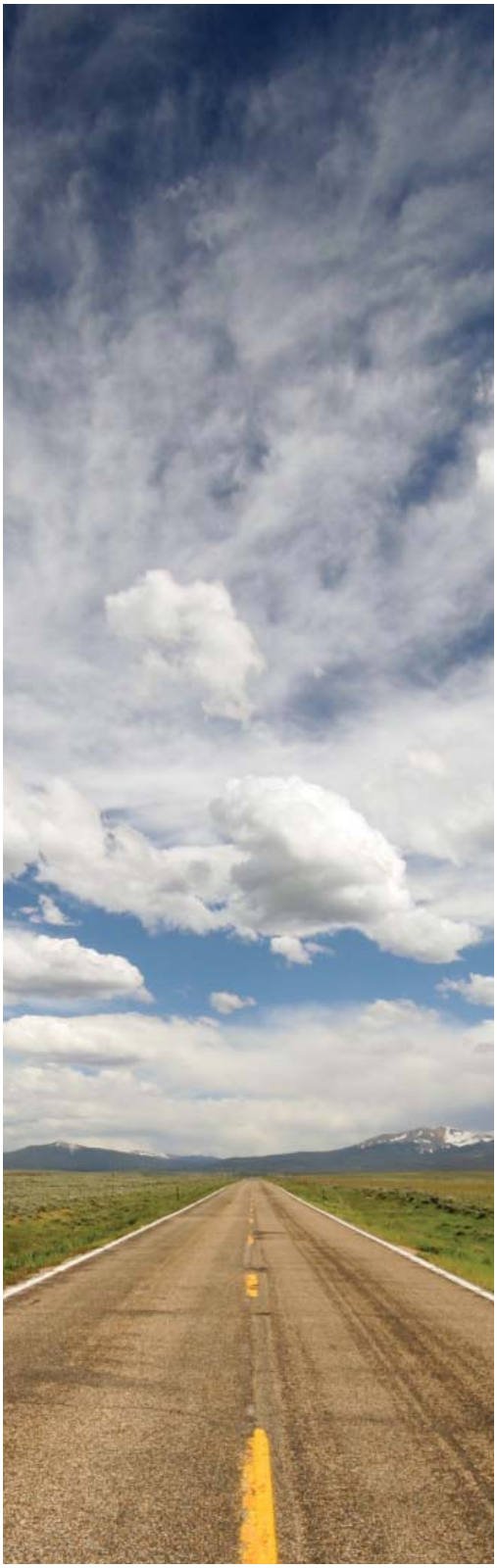
13. Observed Seat Belt Use: Front Range, Western Region and Eastern Plains
Source: Colorado State University Annual Seat Belt Survey



This section includes in-depth summaries of three of the state's most problematic counties with respect to traffic safety: Adams County, Pueblo County, Elbert County, Jefferson County and Weld County. It also includes an in-depth summary of Yuma County, the second most populous Eastern Plains county.

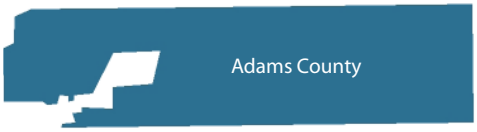
Each summary includes the most recent data available to describe the county's social, demographic, economic and housing characteristics. Data for Adams, Pueblo, Jefferson and Weld counties comes from the 2006 American Community Survey (ACS), a supplement to the Census. Small communities, like Elbert and Yuma counties, while included in the ACS, have insufficient data collected to report publicly. Therefore, the demographic, social, economic and housing data for these counties are from the 2000 Census.

In addition to the data characterizing each county, the county profiles also summarize each county's traffic safety challenges, including young drivers, impaired drivers and occupant protection.



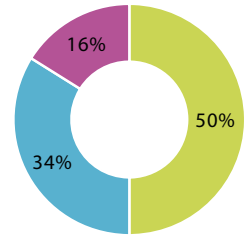
ADAMS COUNTY

A Focus on High-Risk County Population Demographics



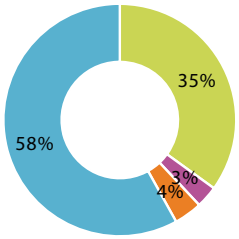
303,748: 2004 Driving Age Population
414,338: 2006 Total County Population
7% Are 15 to 19 Years Old

Place of Birth



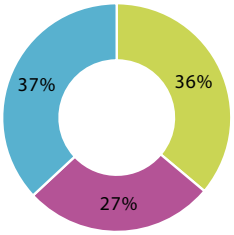
- Born in Colorado
- Born in Other U.S. States
- Born Outside the U.S.

Race/Ethnicity



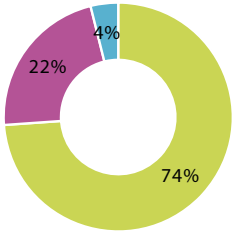
- Hispanic or Latino
- African American
- Asian
- All Others

Year Households Moved to Current Residence



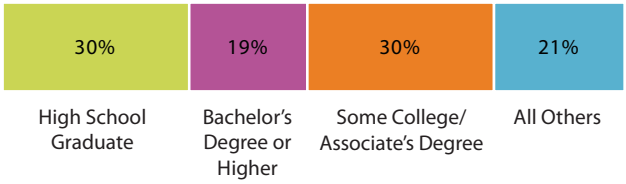
- 2000 - 2004
- 2005
- All Other Years

Language Spoken in the Home

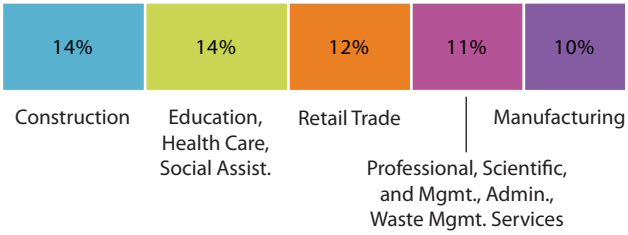


- English Only
- Spanish
- Other Language

Completed Levels of Education



Top 5 Employment Sectors



ADAMS COUNTY

A Focus on High-Risk County Crash Trend Behavior

With **8,417** PDO crashes, **2,746** injury crashes, **45** fatal crashes, Adams County has the **2nd highest** odds of crashing out of all 64 counties and licensed residents have a **4% probability of crash involvement***

1. Estimated Economic Cost

Source: 2004 CDOT Crash Data and Estimates from National Safety Council

7th Highest County

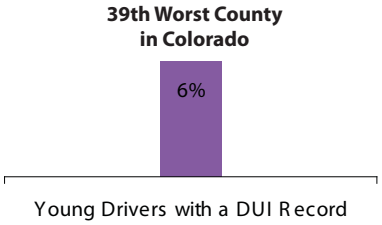
$1,236,070

Injury & Fatal Crashes per 1,000 Capita

YOUNG DRIVERS IN ADAMS COUNTY

2. Drivers Under Age 21 With a DUI Record on Adjudicated Citation Histories

Source: 2004 CDOT Crash Data



3. 4 of the 10 Worst Zip Codes Statewide Where Young Drivers Had the Highest Odds of Crash Involvement

Source: 2004 CDOT Crash Data

County	Zip Code	City
Adams	80022	Commerce City
Adams	80260	Thornton
Adams	80229	Thornton
Adams	80223	Thornton

*Source is 2004 CDOT Crash Data.

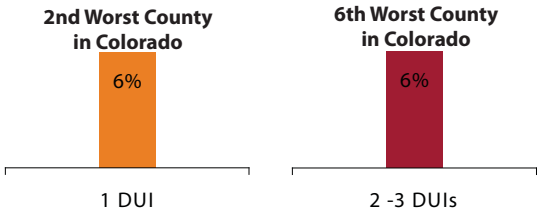
**Ranked 14th worst county out of 25 counties.
Source is Colorado State University, Annual Seat Belt Survey, 2007

*** Ranked 3rd worst county out of the 11 largest counties.
Source: 2004 CDOT Crash Data

IMPAIRED DRIVERS IN ADAMS COUNTY

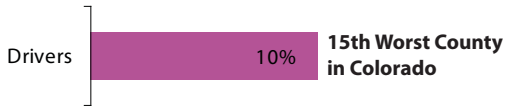
4. Probability of Crashing with Past History of a DUI

Source: 2004 CDOT Crash Data



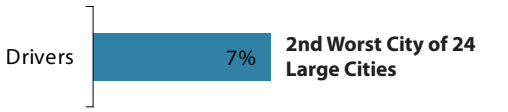
5. Drivers 21 and Older Who Have a DUI on Record

Source: 2004 CDOT Crash Data

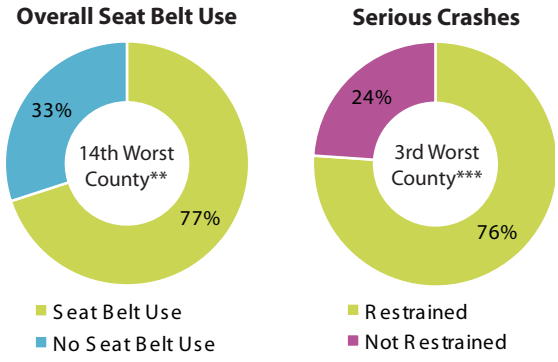


6. Rank of City of Northglenn Among Large Cities with Impaired Drivers in Serious Crashes

Source: 2004 CDOT Crash Data



OCCUPANT PROTECTION IN ADAMS COUNTY

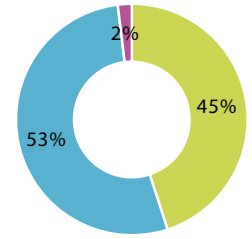


ELBERT COUNTY

A Focus on High-Risk County Population Demographics

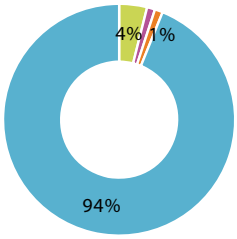
18,061: 2004 Driving Age Population
19,872: 2000 Total County Population
8% Are 15 to 19 Years Old

Place of Birth



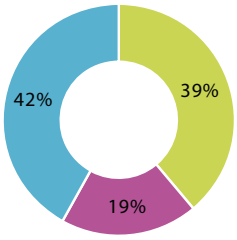
- Born in Colorado
- Born in Other U.S. States
- Born Outside the U.S.

Race/Ethnicity



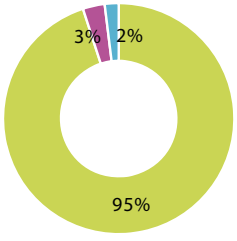
- Hispanic or Latino
- African American
- Asian
- All Others

Year Households Moved to Current Residence



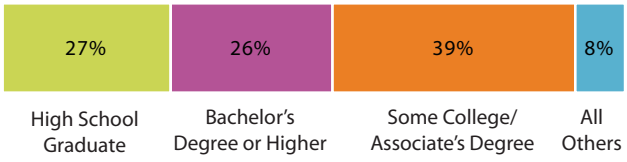
- 1995 - 1998
- 1999
- All Other Years

Language Spoken in the Home

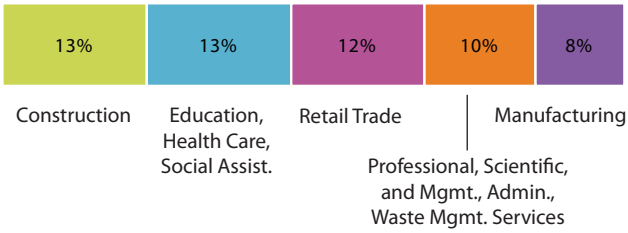


- English Only
- Spanish
- Other Language

Completed Levels of Education



Top 5 Employment Sectors



ELBERT COUNTY

A Focus on High-Risk County Crash Trend Behavior

With **249** PDO crashes, **119** injury crashes, **9** fatal crashes,
Elbert County has the **highest** odds of crashing out of all 64 counties
and licensed residents have a **4% probability of crash involvement***

1. **Estimated Economic Cost**
Source: 2004 CDOT Crash Data and Estimates from National Safety Council

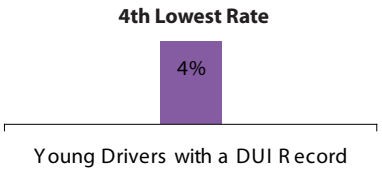
3rd Highest County

$1,528,230

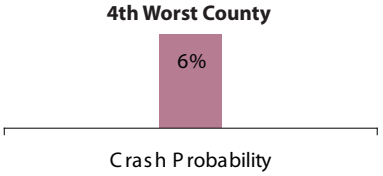
Injury & Fatal Crashes per 1,000 Capita

YOUNG DRIVERS IN ELBERT COUNTY

2. **Drivers Under Age 21 With a DUI Record on Adjudicated Citation Histories**
Source: 2004 CDOT Crash Data

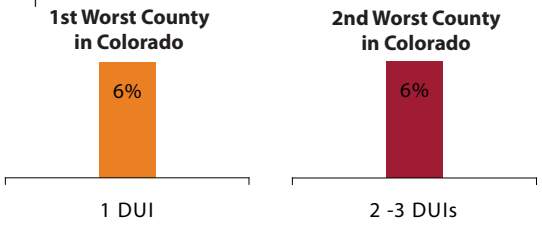


3. **Probability That an Elbert County Driver Under Age 21 Will be in a Crash**
Source: 2004 CDOT Crash Data

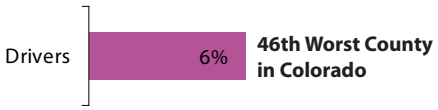


IMPAIRED DRIVERS IN ELBERT COUNTY

4. **Probability of Crashing with Past History of a DUI**
Source: 2004 CDOT Crash Data

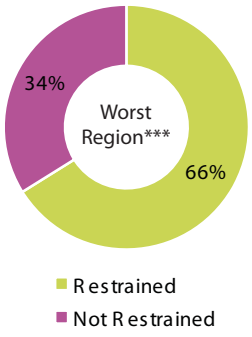


5. **Drivers 21 and Older Who Have a DUI on Record**
Source: 2004 CDOT Crash Data



OCCUPANT PROTECTION ON THE EASTERN PLAINS

Serious Crashes



Previous Page: Population Data is from U.S. Census 2000

**Source is 2004 CDOT Crash Data.*

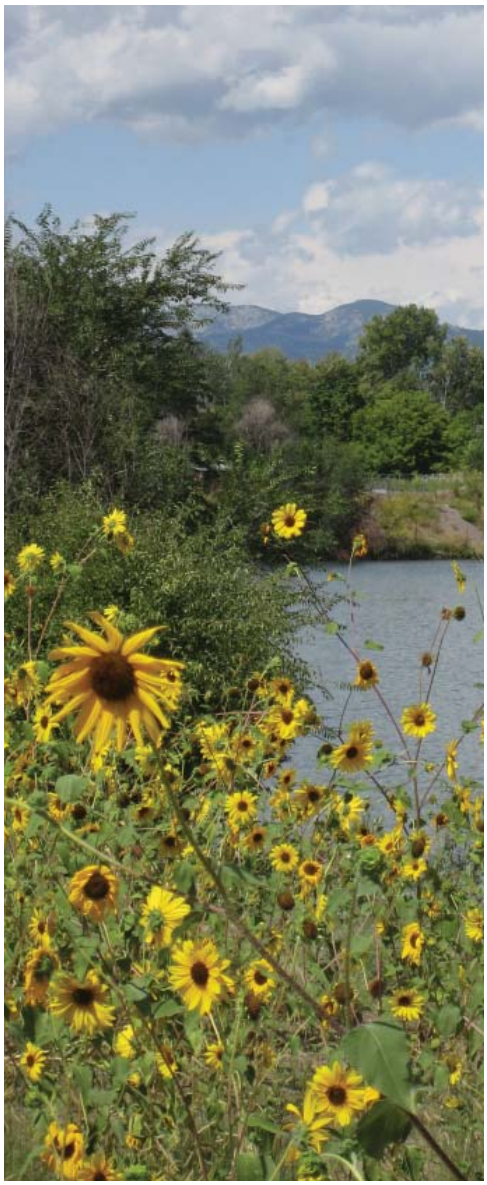
***Ranked 14th worst county out of 25 counties. Source is Colorado State University, Annual Seat Belt Survey, 2007*

**** Ranked 3rd worst county out of the 11 largest counties. Source: 2004 CDOT Crash Data*

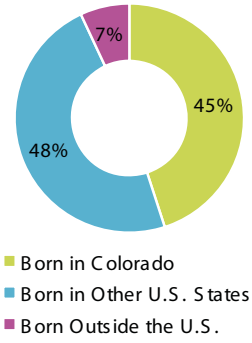
JEFFERSON COUNTY

A Focus on High-Risk County Population Demographics

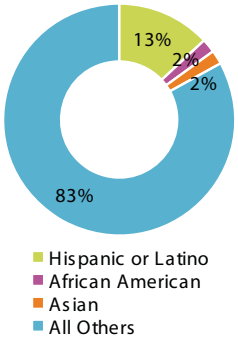
438,386: 2004 Driving Age Population
526,994: 2006 Total County Population
7% Are 15 to 19 Years Old



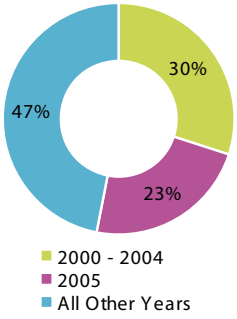
Place of Birth



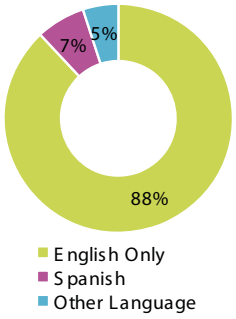
Race/Ethnicity



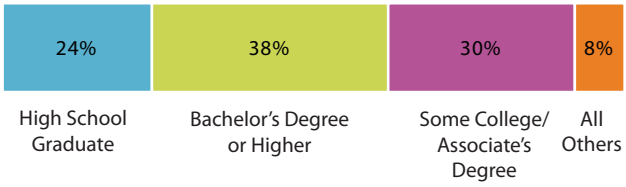
Year Households Moved to Current Residence



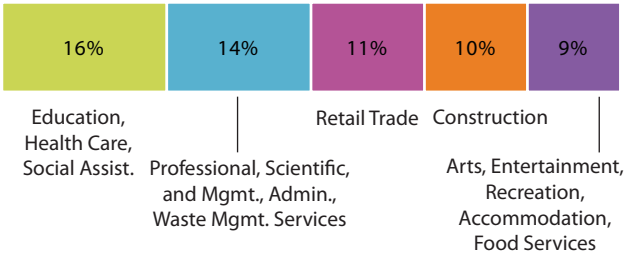
Language Spoken in the Home



Completed Levels of Education



Top 5 Employment Sectors



JEFFERSON COUNTY

A Focus on High-Risk County Crash Trend Behavior

With **9,743** PDO crashes, **2,840** injury crashes, **38** fatal crashes, Jefferson County has the **6th highest** odds of crashing out of all 64 counties and licensed residents have a **3.7% probability of crash involvement***

1. **Estimated Economic Cost**
Source: 2004 CDOT Crash Data and Estimates from National Safety Council

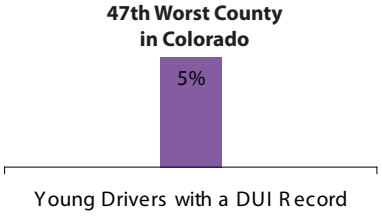
20th Highest County

$1,022,010

Injury & Fatal Crashes per 1,000 Capita

YOUNG DRIVERS IN JEFFERSON COUNTY

2. **Drivers Under Age 21 With a DUI Record on Adjudicated Citation Histories**
Source: 2004 CDOT Crash Data



3. **1 of the 10 Worst Zip Codes Statewide Where Young Drivers Had the Highest Odds of Crash Involvement**
Source: 2004 CDOT Crash Data

1 of the 10 Worst Zip Codes

County	Zip Code	City
Jefferson	80214	Lakewood/Wheat Ridge

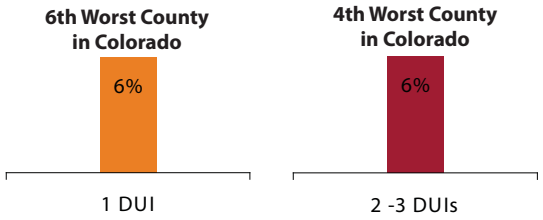
*Source is 2004 CDOT Crash Data.

**Ranked 14th worst county out of 25 counties.
Source is Colorado State University, Annual Seat Belt Survey, 2007

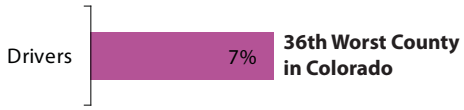
*** Ranked 3rd worst county out of the 11 largest counties.
Source: 2004 CDOT Crash Data

IMPAIRED DRIVERS IN JEFFERSON COUNTY

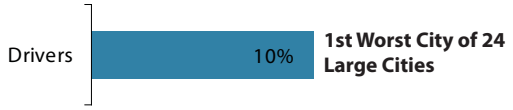
4. **Probability of Crashing with Past History of a DUI**
Source: 2004 CDOT Crash Data



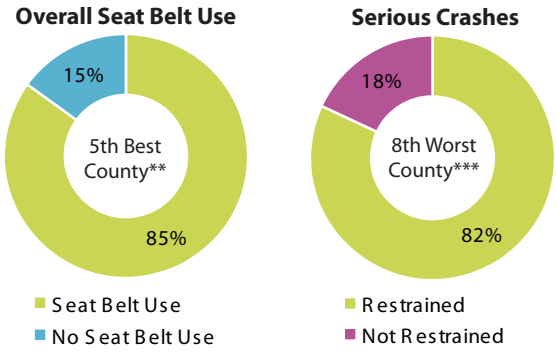
5. **Drivers 21 and Older Who Have a DUI on Record**
Source: 2004 CDOT Crash Data



6. **Rank of City of Littleton Among Large Cities with Impaired Drivers in Serious Crashes**
Source: 2004 CDOT Crash Data



OCCUPANT PROTECTION IN JEFFERSON COUNTY

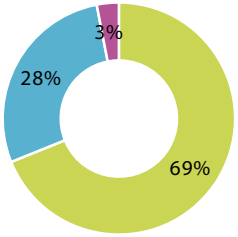


PUEBLO COUNTY

A Focus on High-Risk County Population Demographics

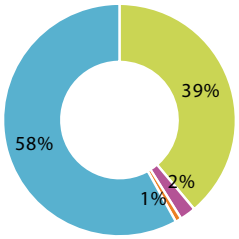
121,023: 2004 Driving Age Population
152,912: 2006 Total County Population
7% Are 15 to 19 Years Old

Place of Birth



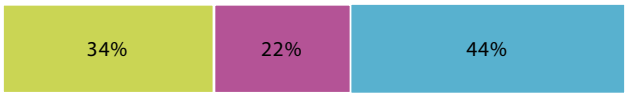
- Born in Colorado
- Born in Other U.S. States
- Born Outside the U.S.

Race/Ethnicity



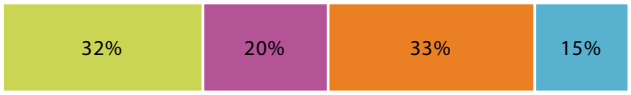
- Hispanic or Latino
- African American
- Asian
- All Others

Year Households Moved to Current Residence



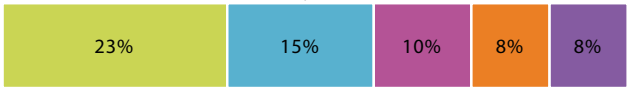
2000 - 2004 | 2005 | All Other Years

Completed Levels of Education



High School Graduate | Bachelor's Degree or Higher | Some College/ Associate's Degree | All Others

Top 5 Employment Sectors



Education, Health Care, Social Assist. | Retail Trade | Construction | Manufacturing | Professional, Scientific, and Management, Administration, Waste Management Services

PUEBLO COUNTY

A Focus on High-Risk County Crash Trend Behavior

With **3,066** PDO crashes, **1,196** injury crashes, **21** fatal crashes, Pueblo County has the **3rd highest** odds of crashing out of all 64 counties and licensed residents have a **4% probability of crash involvement***

1. Estimated Economic Cost

Source: 2004 CDOT Crash Data and Estimates from National Safety Council

5th Highest County

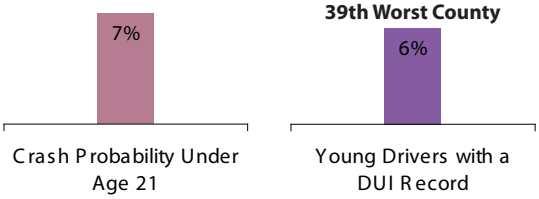
$1,297,340

Injury & Fatal Crashes per 1,000 Capita

YOUNG DRIVERS IN PUEBLO COUNTY

2. Crash Probability for Residents Under Age 21 and Drivers Under Age 21 With a DUI Record on Adjudicated Citation Histories

Source: 2004 CDOT Crash Data



3. 4 of the 10 Worst Zip Codes Statewide Where Young Drivers Had the Highest Odds of Crash Involvement

Source: 2004 CDOT Crash Data

County	Zip Code	City
Pueblo	81004	Pueblo
Pueblo	81001	Pueblo
Pueblo	81007	Pueblo
Pueblo	81006	Pueblo

*Source is 2004 CDOT Crash Data.

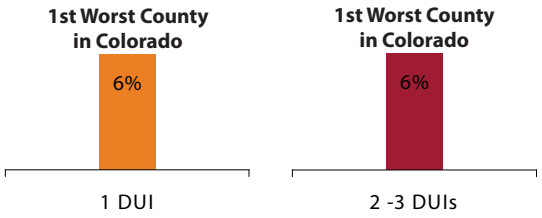
**Ranked 14th worst county out of 25 counties.
Source is Colorado State University, Annual Seat Belt Survey, 2007

*** Ranked 3rd worst county out of the 11 largest counties.
Source: 2004 CDOT Crash Data

IMPAIRED DRIVERS IN PUEBLO COUNTY

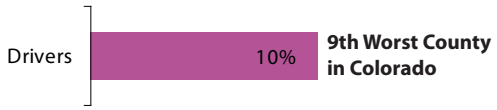
4. Probability of Crashing with Past History of a DUI

Source: 2004 CDOT Crash Data



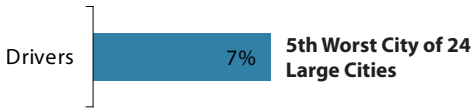
5. Drivers 21 and Older Who Have a DUI on Record

Source: 2004 CDOT Crash Data

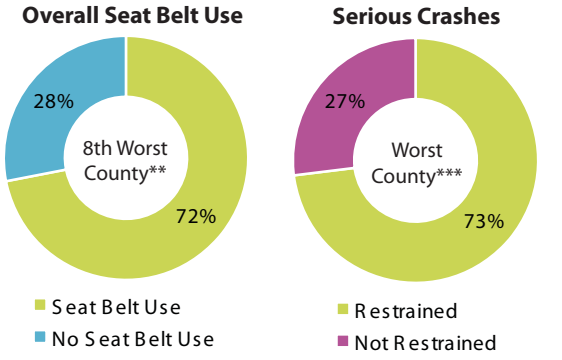


6. Rank of City of Pueblo Among Large Cities with Impaired Drivers in Serious Crashes

Source: 2004 CDOT Crash Data



OCCUPANT PROTECTION IN PUEBLO COUNTY

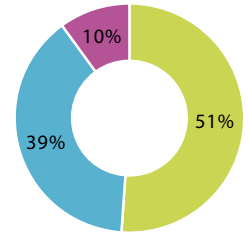


WELD COUNTY

A Focus on High-Risk County Population Demographics

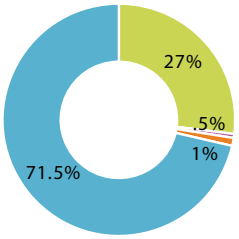
169,845: 2004 Driving Age Population
236,857: 2006 Total County Population
8% Are 15 to 19 Years Old

Place of Birth



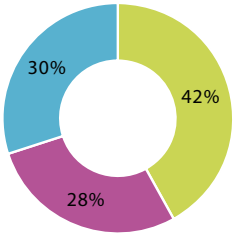
- Born in Colorado
- Born in Other U.S. States
- Born Outside the U.S.

Race/Ethnicity



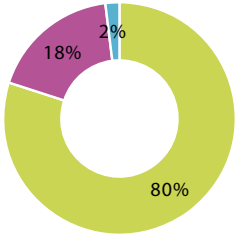
- Hispanic or Latino
- African American
- Asian
- All Others

Year Households Moved to Current Residence



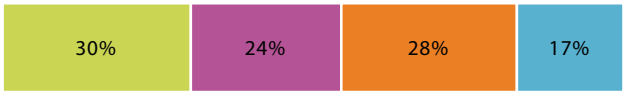
- 2000 - 2004
- 2005
- All Other Years

Language Spoken in the Home



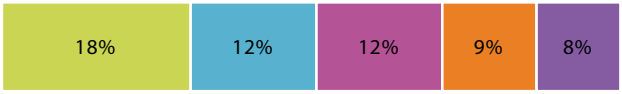
- English Only
- Spanish
- Other Language

Completed Levels of Education



High School Graduate | Bachelor's Degree or Higher | Some College/ Associate's Degree | All Others

Top 5 Employment Sectors



Education, Health Care, Social Assist. | Construction | Retail Trade | Manufacturing | Arts, Entertainment, Recreation, Accommodation, Food Services

WELD COUNTY

A Focus on High-Risk County Crash Trend Behavior

With **3,871** PDO crashes, **1,416** injury crashes, **70** fatal crashes, Weld County has the **10th highest** odds of crashing out of all 64 counties and licensed residents have a **3.5% probability of crash involvement***

1. Estimated Economic Cost

Source: 2004 CDOT Crash Data and Estimates from National Safety Council

4th Highest County

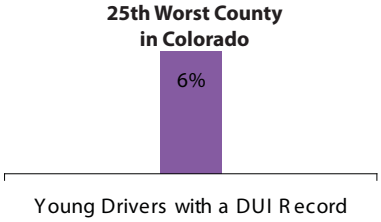
$1,343,540

Injury & Fatal Crashes per 1,000 Capita

YOUNG DRIVERS IN WELD COUNTY

2. Drivers Under Age 21 With a DUI Record on Adjudicated Citation Histories

Source: 2004 CDOT Crash Data



3. Worst Zip Codes Statewide Where Young Drivers Had the Highest Odds of Crash Involvement

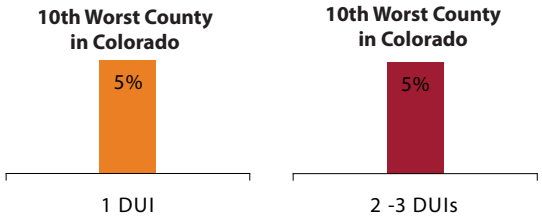
Source: 2004 CDOT Crash Data

None of the ten worst zip codes statewide where young drivers had the highest odds of crash involvement **were in Weld County**

IMPAIRED DRIVERS IN WELD COUNTY

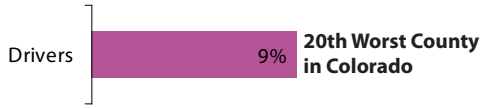
4. Probability of Crashing with Past History of a DUI

Source: 2004 CDOT Crash Data

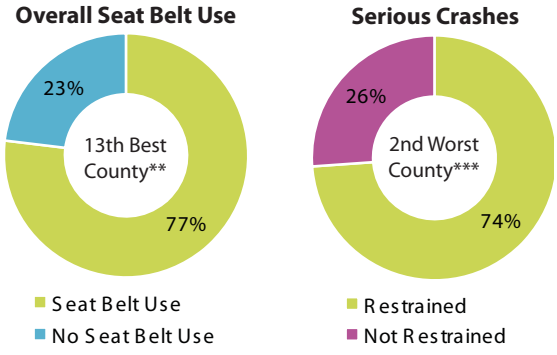


5. Drivers 21 and Older Who Have a DUI on Record

Source: 2004 CDOT Crash Data



OCCUPANT PROTECTION IN WELD COUNTY



*Source is 2004 CDOT Crash Data.

**Ranked 14th worst county out of 25 counties. Source is Colorado State University, Annual Seat Belt Survey, 2007

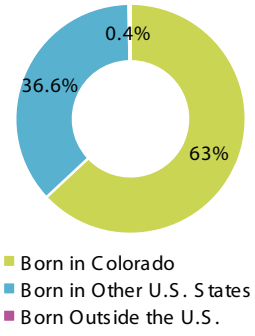
*** Ranked 3rd worst county out of the 11 largest counties. Source: 2004 CDOT Crash Data

YUMA COUNTY

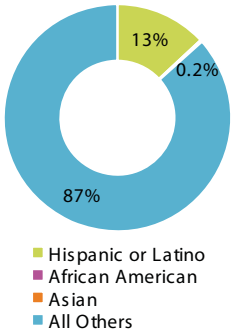
A Focus on High-Risk County Population Demographics

7,956: 2004 Driving Age Population
9,841: 2000 Total County Population
8% Are 15 to 19 Years Old

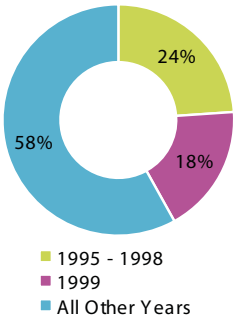
Place of Birth



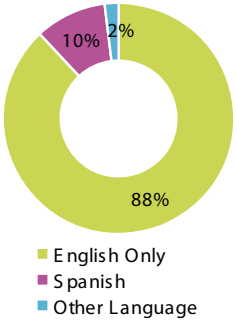
Race/Ethnicity



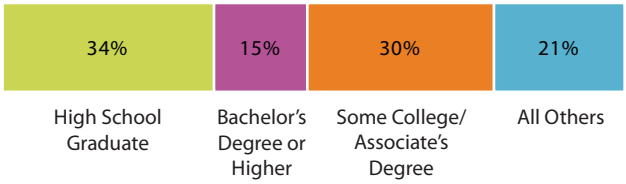
Year Households Moved to Current Residence



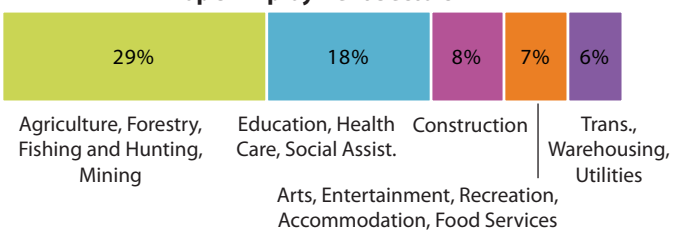
Language Spoken in the Home



Completed Levels of Education



Top 5 Employment Sectors



YUMA COUNTY

A Focus on High-Risk County Crash Trend Behavior

With **140** PDO crashes, **41** injury crashes, **4** fatal crashes,
Yuma County has the **16th lowest** odds of crashing out of all 64 counties
and licensed residents have a **2% probability of crash involvement***

1. **Estimated Economic Cost**
Source: 2004 CDOT Crash Data and Estimates from National Safety Council

6th Highest County

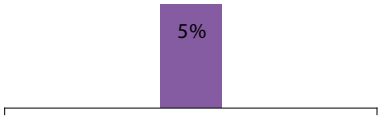
$1,291,510

Injury & Fatal Crashes per 1,000 Capita

YOUNG DRIVERS IN YUMA COUNTY

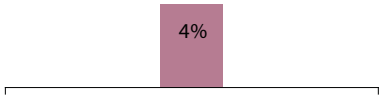
2. **Drivers Under Age 21 With a DUI Record on Adjudicated Citation Histories**
Source: 2004 CDOT Crash Data

16th Lowest Rate



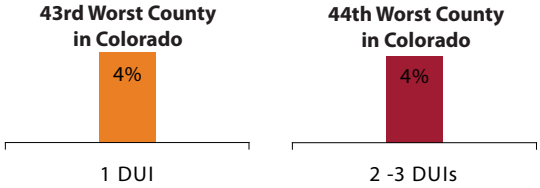
3. **Probability That an Elbert County Driver Under Age 21 Will be in a Crash**
Source: 2004 CDOT Crash Data

15th Best County

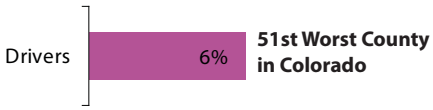


IMPAIRED DRIVERS IN YUMA COUNTY

4. **Probability of Crashing with Past History of a DUI**
Source: 2004 CDOT Crash Data

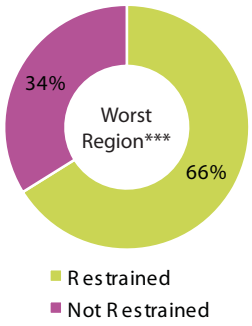


5. **Drivers 21 and Older Who Have a DUI on Record**
Source: 2004 CDOT Crash Data



OCCUPANT PROTECTION ON THE EASTERN PLAINS

Serious Crashes



Previous Page: Population Data is from U.S. Census 2000

**Source is 2004 CDOT Crash Data.*

***Ranked 14th worst county out of 25 counties. Source is Colorado State University, Annual Seat Belt Survey, 2007*

**** Ranked 3rd worst county out of the 11 largest counties. Source: 2004 CDOT Crash Data*

Counties to Focus On

Based on the results of the ordered probit model, the analysis of the 2004 crash data and the 2007 Annual Seat Belt Survey, the study team recommends that the Safety and Traffic Engineering Branch consider developing, supporting or expanding traffic safety programs in the following communities:

- Adams County
- Pueblo County
- Elbert County
- Yuma County

Adams County. Adams County needs a comprehensive traffic safety program that includes components addressing impaired driving, occupant protection and young drivers. It is imperative that the program not solely address young drivers, but adults as well. The program should include community-based social marketing efforts and education as well as law enforcement focused on seat belts and impaired driving. It is important to note that more information is needed to refine the target audiences for programs in Adams County. For example, if local seat belt surveys could be conducted, the program partners would have a better sense of the demographics of Adams County drivers who do not use seat belts (e.g., age, race/ethnicity, vehicle type) as well as the parts of the County where drivers are least likely to use seat belts (e.g., urban vs. rural).

Elbert County. Elbert County's biggest problem, according to the data, is that Elbert County licensed drivers have the highest odds of being involved in a crash, compared to all other counties. Elbert also has a disproportionately high cost per capita of injury and fatal crashes. The model estimates that Elbert County drivers with one DUI record are 6% more likely to be involved in a crash – the second highest rate among all 64 counties. Low seat belt use is assumed because Elbert County is located on the Eastern Plains, which traditionally has low seat belt use. If a comprehensive program is initiated in Elbert County, an observational seat belt survey should be a component to both assess overall seat belt use and set a baseline for future reference.

Pueblo County. Pueblo County needs a comprehensive traffic safety program that addresses adult impaired drivers, occupant protection and young drivers. It is important that young driver programs include all drivers age 21 and younger, not just those still in high school. Community-based programs should reach out to community colleges and large employers of younger

workers. It is also important that adults be included in the impaired driving and occupant protection efforts and that both community outreach as well as enforcement are components of the program. More information is needed to refine the target audiences for programs. For example, what types of Pueblo residents were not using their seat belts when the statewide survey was conducted?

Yuma County. Among Eastern Plains counties, Yuma County has the third highest economic cost of injury and fatal crashes per capita. Because Yuma County has one of the larger driving age populations on the Eastern Plains, Yuma County may be a good location to pilot a community-based occupant protection program tailored to the values and experiences of Eastern Plains communities. If the program is successful, it should be expanded to the other Eastern Plains communities. A seat belt survey should be conducted prior to investing significantly in a seat belt program to confirm the strong suspicion that seat belt use is a problem in Yuma County.

Data Needed

Occupant Protection Data. As discussed throughout this report, the analyses of occupant protection, in particular, are limited by the accuracy of available data. The Annual Seat Belt Survey conducted by Colorado State University represents the best and most reliable point-in-time data on seat belt use statewide. In FY2007, the survey was expanded to include additional observations of seat belt use by racial and ethnic minorities. The study team would recommend that, if dollars are available, the survey include a supplemental component featuring observations in more than 25 counties, particularly on the Eastern Plains where seat belt use traditionally lags the Front Range. It would also be valuable for the data collected on children and young adults to be reported on the county-level, in addition to the currently available statewide estimate.

Although occupant protection data collected as part of fatal and severe crash investigations is more accurate, the very small number of such crashes, particularly in small counties, makes the seat belt data impossible to accurately interpret. Basing a small county's estimates of seat belt use, for example, on the small number of severe injury and fatal crashes would be invalid.

Original Citation File. The ordered probit model estimated the probability of crashing using a wide array of data from the Motor Vehicle Division. Chief among these databases is the adjudicated citation file. If possible to obtain, the original citation file in addition to adjudicated citations would provide a rich dataset and would allow the study team to vastly expand its analyses.

Current Crash Data. Obviously, more current crash data is needed for the analyses to have improved relevance for program development and selection.

Recommended Analytical Focus for FY2009

The study team recommends that future Problem Identification reports continue to emphasize place-based analyses and expand those analyses whenever possible. With sufficient time for data collection, cleaning and analysis, we believe that the model can be expanded to include demographic data on the census tract level, as well as sub-analyses such as looking at the impact of recent citations or address changes by county.

Past Problem ID projects have attempted to understand the crash experiences of Colorado drivers by constructing multiple cross-tabulations. These cross-tabulations are convenient for presentational purposes. However, they are unavoidably reductionist. Each focuses on a small number of crash and driver characteristics. The exclusion of other characteristics that may also be important could lead to false inferences from any or all of such cross-tabulations.

The 2008 Problem ID project presents a new way of interpreting the annual crash experiences of Colorado drivers. This project takes a more comprehensive approach to the analysis of crash experiences. It characterizes each Colorado resident with a Colorado driver's license based on all available information about that driver as of 31 December 2003. It then imputes the probability that each driver will be involved in a property-damage-only, injury or fatal crash during the year. These imputed probabilities can then be aggregated to identify demographic groups or geographic areas which contain high concentrations of at-risk drivers.

The foundation for these imputations is the data held by the Colorado Department of Revenue (DOR) in its various files regarding drivers licenses, traffic violations and sanctions. These files yield measures of age, sex, height, weight, county of residence, residential mobility, numbers and points from past citations, duration since last citation, numbers of DUI records, BAC scores, and refusals to surrender licences or to take BAC tests at DUI stops. These measures, matched with actual 2004 crash experiences in an ordered probit analysis, yield estimates of how each measured characteristic affects the probability of experiencing a crash of any given severity.

The table shown on the following page presents these estimates. The coefficients estimate the effect of each characteristic on the propensity of a driver to become involved in a crash. Almost all of these effects are statistically significant by conventional standards. However, the sample size is huge, 5,333,258 drivers. Consequently, it is appropriate to set more rigorous standards for the purpose of interpretation.

Many of these effects are both significant and immediately plausible.

For example, older drivers and women are significantly less likely to become involved in crashes than younger drivers and men. Drivers whose residences have been more stable, as measured both by the number

1. Ordered Probit Estimates of Determinants of Crash Severity
Source: Colorado Department of Transportation

Severity	Coeficient	Stand. Error	z	P > |z|
age	-0.0049192	0.0000752	-65.44	0.000
sex	-0.0468804	0.0031727	-14.78	0.000
donor	0.075732	0.0022795	33.22	0.000
newheight	-0.0073922	0.0004190	-17.64	0.000
weight	0.0008658	0.0000380	22.78	0.000
count	-0.0023199	0.0004209	-5.51	0.000
duration	-0.0570444	0.0003981	-143.29	0.000
numcitation	0.0189506	0.0005411	35.02	0.000
numpoints	-0.001135	0.0000431	-26.33	0.000
citduration	-0.0126289	0.0001382	-91.39	0.000
duinumber	-0.0162912	0.0072489	-2.25	0.025
dnosurrender	-0.0370539	0.0054207	-6.84	0.000
dnotest	0.0217854	0.0078362	2.78	0.005
dbac	-0.1421988	0.0806654	-1.76	0.078
maxbac	0.7890422	0.0987746	7.99	0.000
county01	0.4698753	0.1179010	3.99	0.000
county02	0.4249464	0.1194304	3.56	0.000
county03	0.431902	0.1178808	3.66	0.000
county04	0.3316641	0.1200740	2.76	0.006
county05	0.1659253	0.1262908	1.31	0.189
county06	0.3004208	0.1244813	2.41	0.016
county07	0.3825463	0.1179227	3.24	0.001
county08	0.4445285	0.1181183	3.76	0.000
county09	0.3153245	0.1195526	2.64	0.008
county10	0.2550646	0.1307244	1.95	0.051
county11	0.3417452	0.1211928	2.82	0.005
county12	0.410051	0.1218228	3.37	0.001
county13	0.3448221	0.1235260	2.79	0.005
county14	0.2899596	0.1268517	2.29	0.022
county15	0.2864386	0.1252657	2.29	0.022
county16	0.2956327	0.1188933	2.49	0.013
county17	0.4176013	0.1178828	3.54	0.000
county18	0.1837248	0.1337955	1.37	0.170
county19	0.3983202	0.1179478	3.38	0.001
county20	0.1539232	0.1185351	1.3	0.194
county21	0.4729284	0.1189058	3.98	0.000
county22	0.3842584	0.1178836	3.26	0.001
county23	0.3800891	0.1184744	3.21	0.001
county24	0.3735411	0.1186305	3.15	0.002
county25	0.3965634	0.1189542	3.33	0.001
county26	0.2082136	0.1196750	1.74	0.082
county27	0.1713548	0.1198386	1.43	0.153
county29	0.3588825	0.1217975	2.95	0.003
county30	0.3275226	0.1328952	2.46	0.014
county31	0.4703576	0.1178861	3.99	0.000
county32	0.1368734	0.1420374	0.96	0.335
county33	0.3311276	0.1216142	2.72	0.006
county34	0.27342	0.1212956	2.25	0.024
county35	0.3374076	0.1183365	2.85	0.004

of residential records in the DOR database and the length of time since the last change to these records, are significantly less likely to become involved in crashes than are drivers who have changed residences more often and more recently.

Other effects are more subtle, though also plausible. For example, drivers with more citations are significantly more likely to become involved in crashes. Drivers whose citations are more recent are also significantly more likely to become involved in crashes. However, drivers with more points from citations are significantly less likely to become involved in crashes. This presumably demonstrates an important deterrent effect: Drivers with more points have more at risk, should they violate traffic laws again. Therefore, they drive more responsibly.

Interpretations of the remaining effects may require more speculation.

For example, of drivers at the same weight, taller drivers are significantly less likely to become involved in crashes. It may be that the fields of vision for taller drivers are less obstructed by the dashboard and other structural characteristics of their vehicles.

At the same time, among drivers with the same height, heavier drivers are significantly more likely to become involved in a crash. It is possible that heavier drivers are less physically agile, but this effect probably requires more exploration in order to interpret convincingly.

The five available measures of DUI involvement yield estimated effects which are complex and, perhaps, also, require further investigation.

The probabilities of becoming involved in crashes of varying severity, as presented in the 2008 Problem ID document, combine the effects represented by the coefficients in this table with the characteristics of each driver. The simulations in that document take a reference individual with a specified set of characteristics, and vary those characteristics systematically to examine the consequent changes in the probabilities of crash involvement.

The ordered probit analysis makes possible a range of analyses that are more comprehensive and more precise than does the previous practice of cross-tabulation. At the same time, the results here could be improved with additional data. In the future, the predictions could be refined further with the incorporation of past crash experience and perhaps demographic characteristics of the residential location. It would also be improved if the data could identify Colorado license holders who are still resident in the State. The sample of drivers analyzed here must contain many who have left the State or who are deceased, because present DOR records do not identify them.

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