Analysis of Fatal Crashes in Alabama
Over the First 8 Months of 2016

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1. Introduction (PPT 1-2)

This is a narrative summary that should be read in conjunction with a companion Power Point (PP) presentation with the file name TRCC Meeting SHA 16Nov2016-vNN (NN=version number). The sections below generally correspond to the various topics covered in the PP presentation.

This report will be organized as follows:

- Fatality picture for 2016
- Analysis of the data by issue
  - Speed
  - Safety equipment
  - Distracted driving
  - Pedestrians
  - Involved vehicle types
  - Multiple-fatality crashes
- Countermeasure recommendations
- Supporting IMPACT Results

Most of the comparisons that performed for this study were of the first eight months (January through August) of 2016 against the comparable time frame for 2014. An exception is given in the next section since the goal was to show how 2016 was shaping up against 2015. However, it was felt that some of the changes that are being felt in 2016 may have started in 2015, and thus a more vivid contrast is obtained by going back to 2014 for the analyses. The reason for only using the first eight months is the availability of the data at the time that these analyses were initiated. Plans have been made to update this study once the complete 2016 data are available.

2. The 2016 Calendar Year Fatality Picture (PPT 3-5)

Table 1 was created to show the point in 2016 (October 20) at which the 2015 number of fatalities occurred. Based on the first 10 months of 2016, the state is having 26.1% more fatalities than it did in 2015. This is much higher than the projected additional 10% that is being forecast by NHTSA (http://www.safehomealabama.gov/SafetyTopics/GeneralTrafficSafety.aspx). Alabama did not show as large an increase from 2014 to 2015 as was experienced generally throughout the country. It is postulated that Alabama lagged behind the country in this regard and is catching up in 2016. In any event, this result was met with shock throughout the Alabama

traffic safety community, and this was the motivation for the in-depth analysis that is contained in this study.

Table 1 – Fatality Estimates Based on First 10 Months of 2016

	2015	2016
Average Fatalities/Day	2.3	2.9 (+26.1%)
Average Fatalities/Month	71	88
Projected Dec. 31	849 (actual)	1054

Table 2 – Comparison of 2014 with 2016 for All Severity Classifications

CARE Crosstab Results - 2014-2016 Crash Data		
2014 OR 2016 Jan-Aug -- Year vs. Crash Severity		
	First Eight Months	
	2014	2016
Fatal Injury	483	616
	0.56%	0.60%
Incapacitating Injury	3929	4032
	4.57%	3.95%
Non-Incapacitating Injury	6541	7638
	7.60%	7.48%
Possible Injury	7659	9753
	8.90%	9.56%
Property Damage Only	64576	77388
	75.07%	75.83%
Unknown	2836	2621
	3.30%	2.57%
TOTAL	86024	102048
	45.74%	54.26%

Table 2 shows how the various injury severity classifications compare from 2016 to 2014 for the first eight months of both years. The yellow indicates the cells that are statistically significant in having a *higher proportion* than the number in the comparative year. Fatal injury crashes were considerably higher (by 133 crashes and 0.04%) in 2016. However, the proportion of Incapacitation Injury and Possible Injury crashes went down. The lowest injury severity went up

in proportion as well and the PDO crashes. Some preliminary analysis were attempted combining the highest severity classifications, but it was found that this tended to mask some of the differences, and so the ultimate comparisons just looked at the increases in fatality crashes.

Table 3 – View of the Data Actually Compared

	2014	2016
Total Crashes	86,024	102,048 (+18.6%)
Fatality Crashes	483	616 (+27.5%)
Fatalities	536	695 (+29.7%)

Table 3 presents and overall summary of the comparison data. Unless otherwise stated, the comparisons will be between subsets of fatality crashes in the first eight months of 2014 against fatality crashes in the first eight months 2016 ("2014" and "2016" will be used to abbreviate "the first 8 months of 2014 or 2016" in the discussions that follow). When we get to number of fatalities per fatal crash, we will look at actual fatalities, but we have found crashes as opposed to fatalities to be a more reliable metric to compare, since only one, or a few, large fatality crashes can otherwise skew the results.

The following was the general analytics methodology that was applied:

- Isolate those attributes with most significant increases in a high level comparison of fatal crashes of 2016 with 2014. Attributes for further analysis will also be chosen for the capability to develop countermeasures to address them.
- Perform additional analytics on these causes comparing 2016 with 2014.
- Translate these results into recommendations for new countermeasure and existing countermeasure enhancements.

The traffic safety issues will be discussed generally with those that can have the greatest impact on fatality reduction first.

3. Speed (PPT 6-9;xxxx)

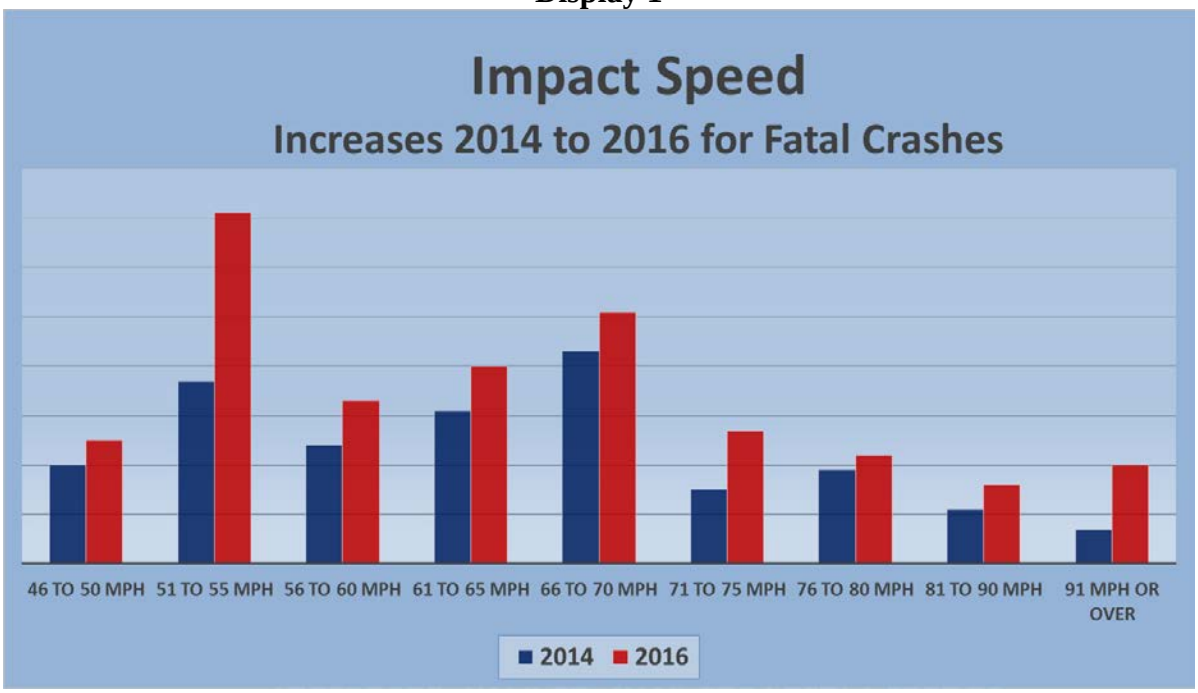
There is a well-known exponential relationship between the probability of a fatal crash and impact speed that was established for decades and validated by the most recent data. As a rule of thumb it states that for every increase of 10 MPH above 40 MPH, the probability of a fatality in the crash doubles; see:

http://www.safehomealabama.gov/SafetyTopics/Enforcement/EnforcementStudies.aspx

It is also known anecdotally throughout the traffic safety community that average travel speeds have been increasing in recent years, most probably due to the lack of patrol officers on the

highways. Thus, impact speed and overall speed enforcement would be one of the first areas to consider.

Display 1



Display 2

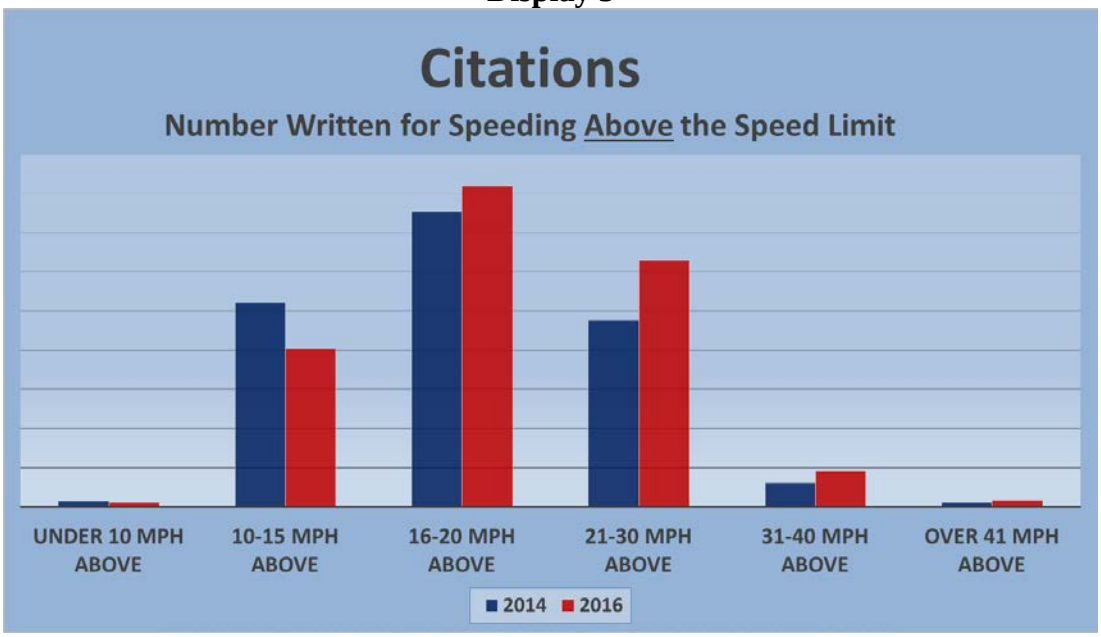
CARE Crosstab Results - 2014-2016 Alabama Integrated Crash Data -					
Filter = 2014 OR 2016 Jan-Aug FATAL -- Year vs. CU Estimated Speed at Impact					
	2014	2016	Increase	% Increase	% of 133 Fatal Crashes
46 to 50 MPH	20	25	5	25.0%	3.8%
51 to 55 MPH	37	71	34	91.9%	25.6%
56 to 60 MPH	24	33	9	37.5%	6.8%
61 to 65 MPH	31	40	9	29.0%	6.8%
66 to 70 MPH	43	51	8	18.6%	6.0%
71 to 75 MPH	15	27	12	80.0%	9.0%
76 to 80 MPH	19	22	3	15.8%	2.3%
81 to 90 MPH	11	16	5	45.5%	3.8%
91 MPH +	7	20	13	185.7%	9.8%
TOTAL	207	305	98	47.3%	73.7%
ALL FATALS	483	616	133	27.5%	

Displays 1 and 2 illustrate the problem with regard to increased speeds, showing that 78% of the fatality increase were due to increases in crash speeds above 45 MPH. The first two columns (titled 2014 and 2016) give the fatality crashes at the respective impact speeds. The % Increase column gives the percent of the increase in 2016 over 2014. The final column at the right gives nth percentage that the increase is of the 133 overall increase in fatality crashes. The area highlighted in red is at the highest impact speeds, showing a 45% increase in the 81-90 MPH and a 185% increase in impact speeds above 91 MPH. These increases in speed should be alarming to all, and clearly demonstrate the need for additional law enforcement on Alabama highways. If the presence of officers could cut the average speed of impacts by 10 MPH, that would cut the number of fatalities in half.

Displays 3 and 4 below show that there has been an overall increase in speeding citations issued of 7.1% between 2014 and 2016 (first 8 months). The decrease in the lower speeds at which tickets have been given generally indicates:

- Higher speeds overall;
- Thus, it has become easier for officers to apprehend extreme violators; and
- Potential reluctance to cite lower violations when there are so many in the higher speed violation categories.

Display 3



Display 4

MPH Above Posted Speed Limit	2014	2016	Increase	% Increase
Under 10 MPH Above	695	515	-180	-25.9%
10-15 MPH Above	26090	20214	-5876	-22.5%
16-20 MPH Above	37711	41041	3330	8.8%
21-30 MPH Above	23879	31450	7571	31.7%
31-40 MPH Above	3080	4506	1426	46.3%
Over 41 MPH Above	503	785	282	56.1%
TOTAL	91958	98511	6553	7.1%

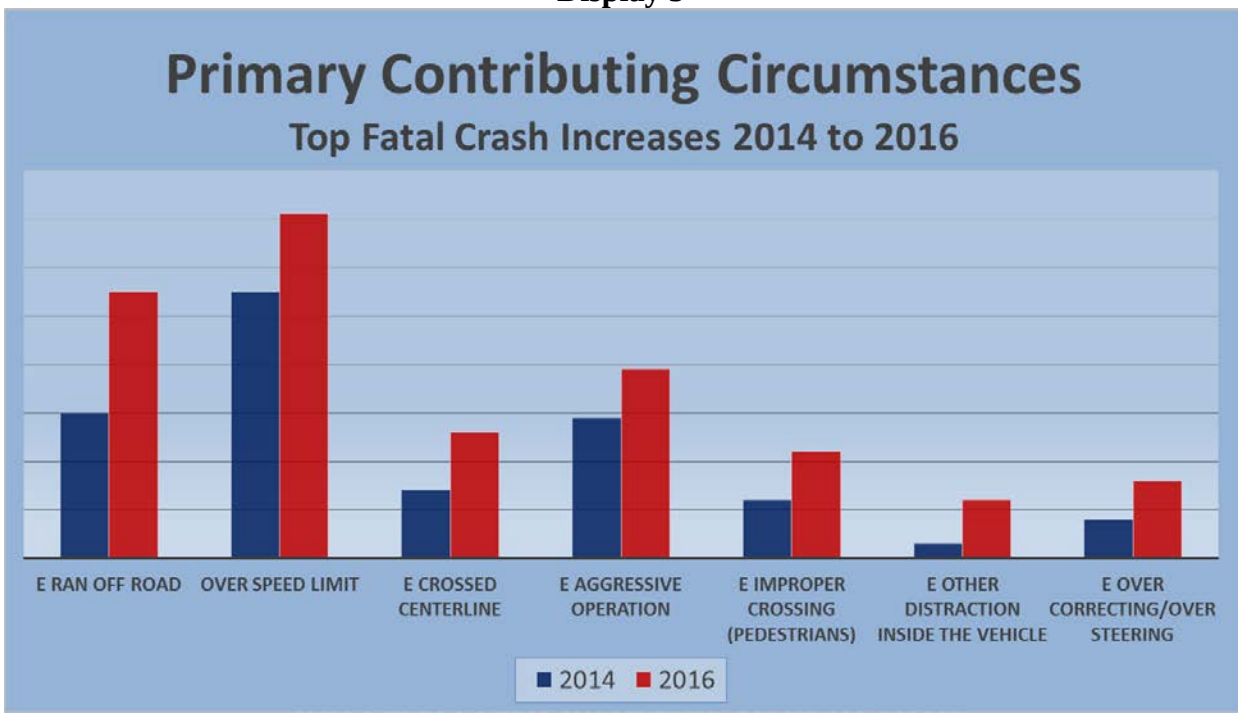
4. Primary Contributing Circumstances (PPT 10-11)

The following were observed from the fatal crash increases when considering Primary Contributing Circumstances (see Displays 5 and 6):

- Some of these categories can be addressed by roadway improvements, for example:
    - Fatalities from ran off the road crashes can be reduced by creating a clear roadside;
    - Centerline Crossings and Over Correcting might be reduced in some places by improved signs and road markings
- Most of these categories are either caused or intensified by excessive speed, which was discussed above in Section 3.
- Numbers drop off quickly for this attribute; notice that the ordering of the values are according to the increase in fatalities experiences in 2016.

All types of distractions will be discussed in Section 6 below.

Display 5

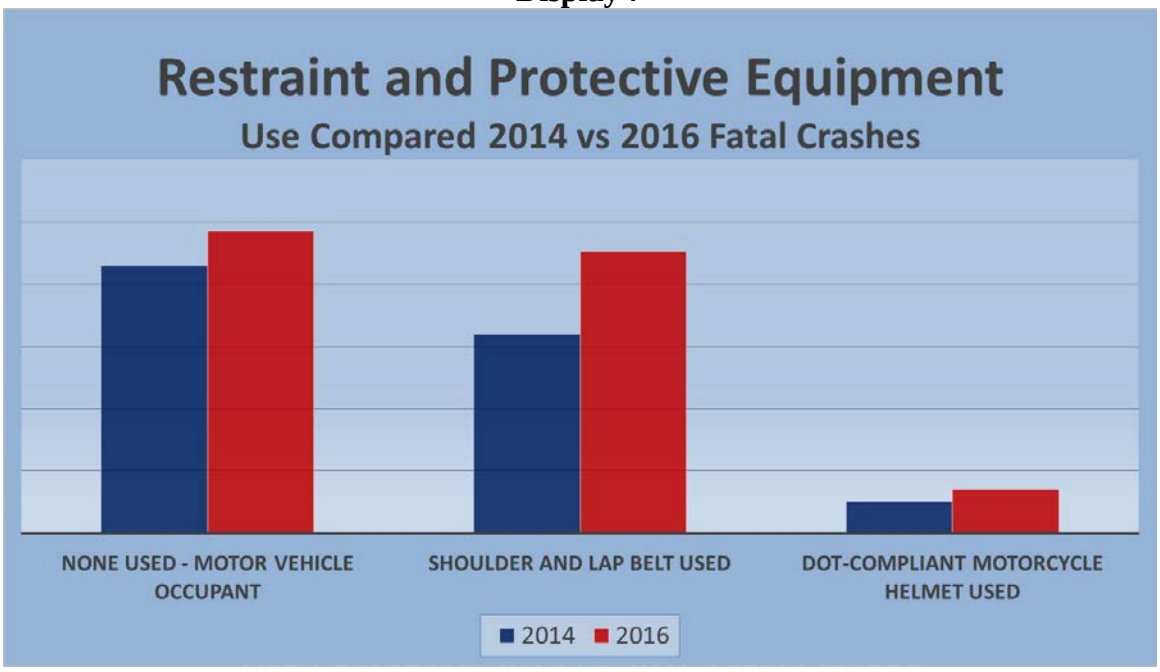


Display 6

Primary Contributing Circumstance	2014	2016	Increase	% Increase	% of 133 fatal crashes
E Ran off Road	30	55	25	83.3%	18.8%
Over Speed Limit	55	71	16	29.1%	12.0%
E Crossed Centerline	14	26	12	85.7%	9.0%
E Aggressive Operation	29	39	10	34.5%	7.5%
E Improper Crossing (Pedestrians)	12	22	10	83.3%	7.5%
E Other Distraction Inside the Vehicle	3	12	9	300.0%	6.8%
E Over Correcting/Over Steering	8	16	8	100.0%	6.0%

5. Restraints and Protective Equipment (PPT 12-15)

Display 7



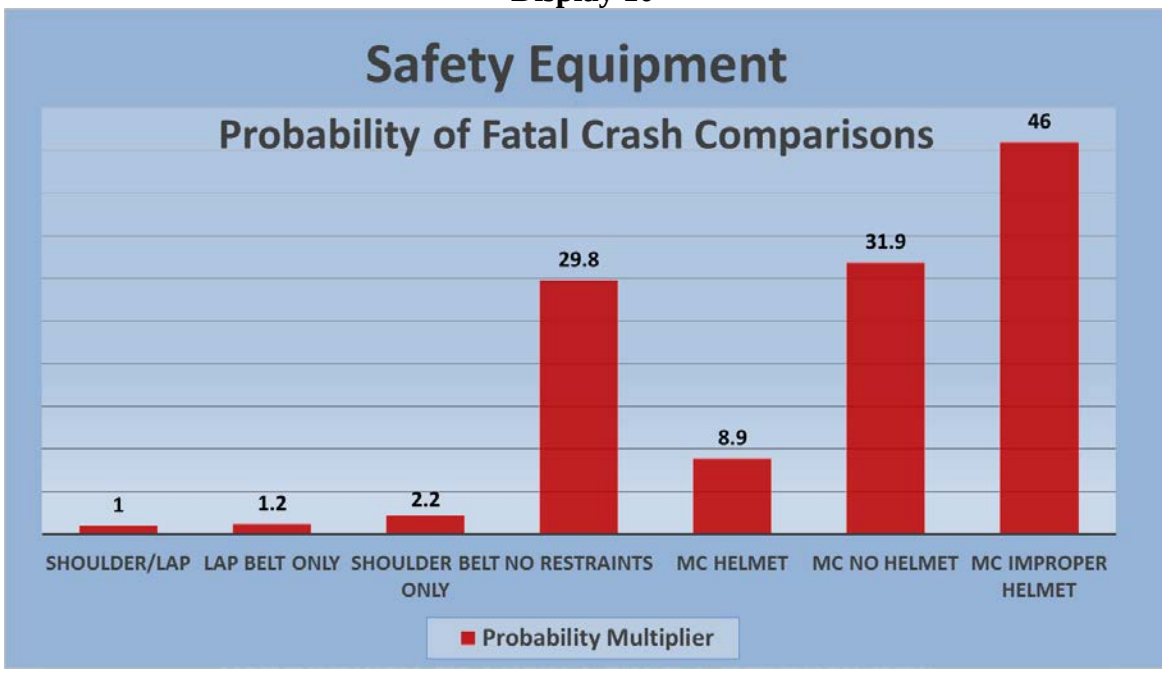
Display 8

	2014	2016	Increase	% Increase	% of 133
None Used – Motor Vehicle Occupant	215	243	28	13.0%	9.9%
Shoulder and Lap Belt Used	160	226	66	41.3%	31.3%
Dot-Compliant Motorcycle Helmet Used	25	35	10	40.0%	30.3%
REDUCED TOTAL	400	504	104	26.0%	19.7%
TOTAL ALL FATALITY CRASHES	483	616	133	27.6%	20.9%
Percent of fatalities Properly Restrained	42.7	48.2			

Display 9

	Fatal	Incapac	Non-Incap	Possible	PDO	TOTAL	Pr(Fatal)	1 in XXX	Times Base
None Used - Motor Vehicle Occupant	881	2698	2725	1014	4207	11756	0.075	13	29.8
Shoulder and Lap Belt Used	792	11096	22144	30205	243743	314966	0.003	398	1.0 (Base)
Lap Belt Only Used	3	38	71	94	773	1028	0.003	343	1.2
Shoulder Belt Only Used	5	33	70	91	657	908	0.006	182	2.2
Dot-Compliant Mot Helmet Used	109	640	746	149	473	2142	0.051	20	20.2
E Helmet Used	5	52	77	19	64	224	0.022	45	8.9
E Other Motorcycle Helmet Used	17	42	55	11	19	147	0.116	9	46.0
No Motorcycle Helmet Used	15	96	52	5	18	187	0.080	12	31.9
TOTAL	2164	16470	29179	35707	292992	387537	0.006	179	2.2

Display 10



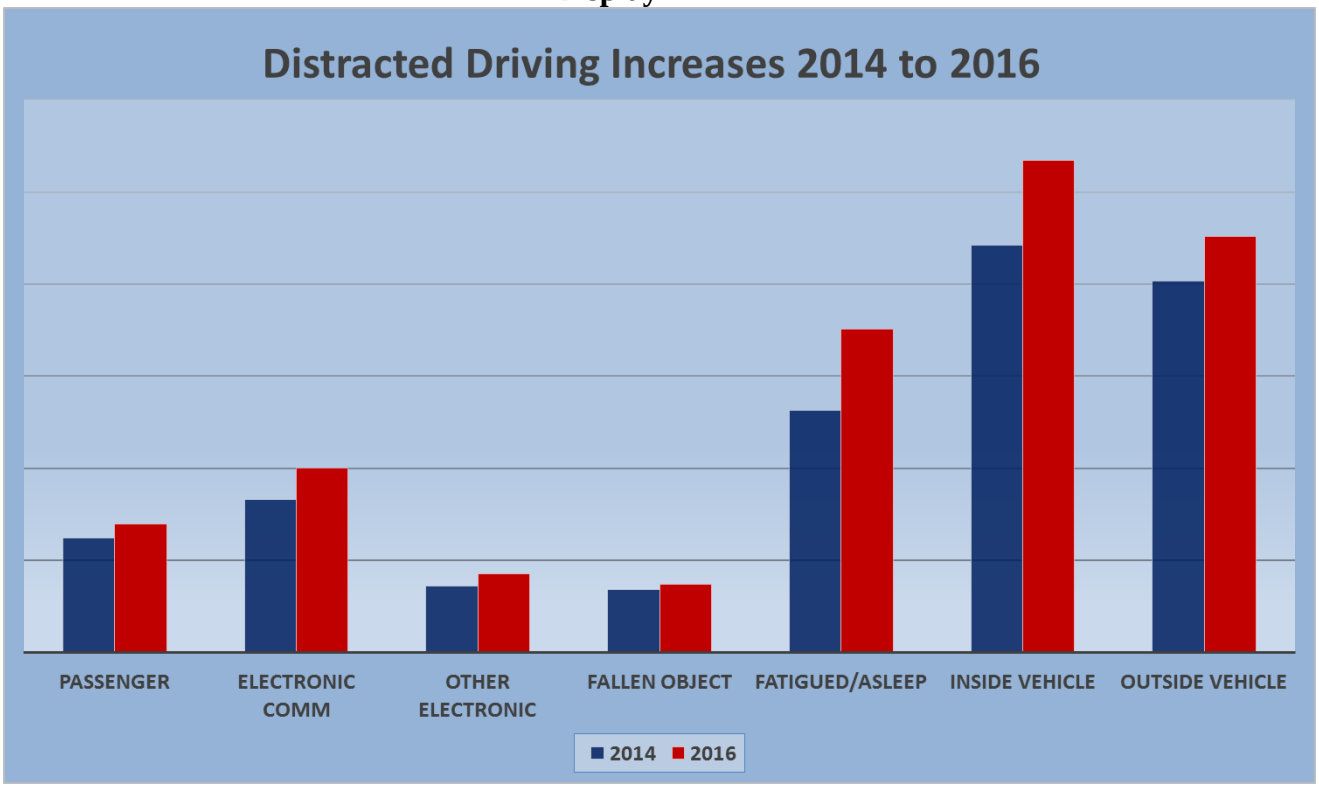
Restraints were considered as a high priority countermeasure for reasons confirmed in the displays. Probably the most impressive is Display 10, which shows for passenger vehicles, the increase in the probability of a crash being fatal if the passengers are not restrained is about 30 times higher when proper restraints are used. Thus, in general, the reduction would be to 1/30th of the fatalities if proper restraints were used, all other things being equal. We realize that in these cases all other things are NOT equal, in that there are a number of other causative factors (e.g., speed and drug/alcohol abuse) that might defeat the general applicability of seatbelts. However, we feel that a conservative estimate of effectiveness in these crashes was 50%, i.e., half of the fatalities that were suffered by those unrestrained would be saved had they vehicle occupants been restrained. This would be 50% of the 243 fatalities in which no restraint was used, or a saving of 122 fatalities. This would reduce the increase from 133 to 11 fatalities (assuming one fatality per fatal crash).

The following is an overview of the display in this section:

- Display 7 – while the overall reported seatbelt rate has increased, the number and proportion not restrained in fatal crashes is still extremely high and should be of major concern – further defined in Display 8.
- Display 8 – the overall seatbelt rate is above 90%, but for fatal injuries it is between 40-50%. Although 2016 showed a slight improvement, it is still well below 50%.
- Display 9 – this table shows the probability that any given person in a crash is fatally injured based on the seatbelt or other protective equipment use. To better visualize these results for Display 10, the raw probabilities are turned into odds (e.g., 1 in 13 for None Used, and 1 in 398 for Shoulder and Lap Belt used). For further visualization, in the last column the odds are turned into a multiplier of the ideal case (Shoulder and Lap Belt used). This shows, for example that None Used has about 30 (29.8) times the probability of resulting in a fatality than the ideal case.
- Display 10 – this displays the right column of Display 9 graphically. Minor increases occur for Lap Belt Only and Shoulder without Lab Belt. However, the large in crease in the odds of being killed is in the non-use category. The three bars to the right have to do with motorcycle safety equipment (e.g., helmets). The best case for a motorcycle crash is 8.9 times worse than the best case for passenger cars. If helmets are not worn, the multiplier is 31.8, and if a non-DOT-compliant helmet is used it goes up to a 46 multiplier (showing that the non-compliant helmet is worse than no helmet at all).

6. Distracted Driving

Display 11



Display 12

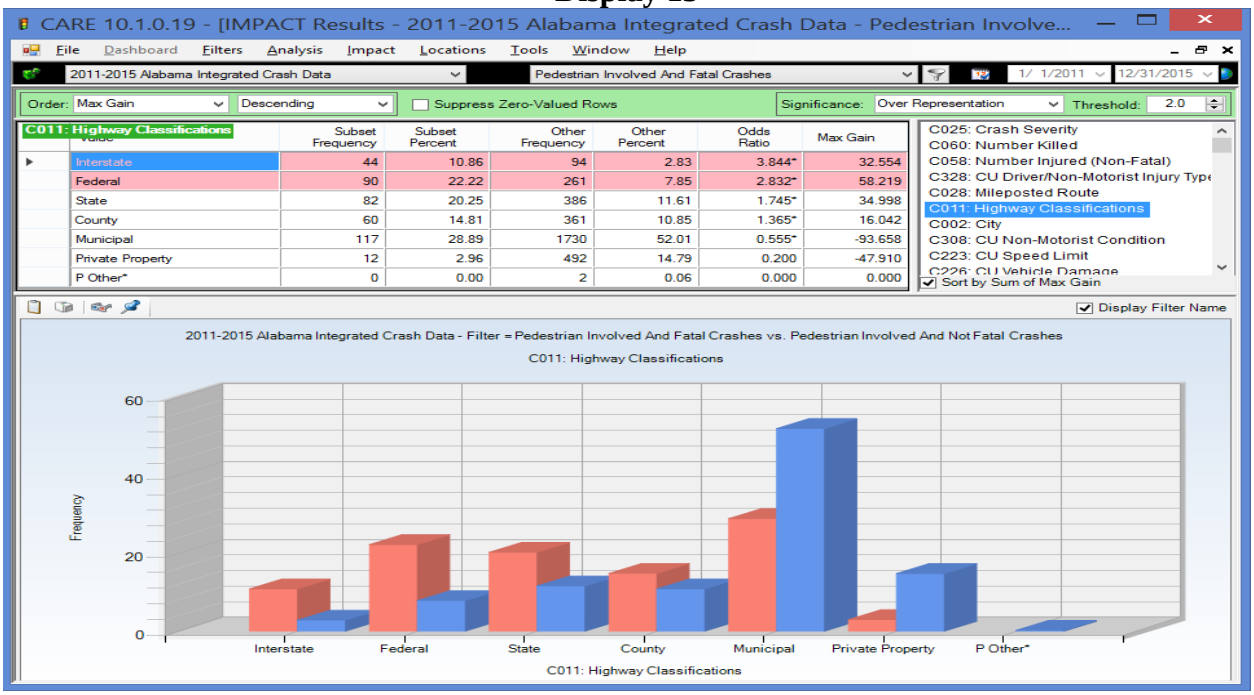
Distracted by …	2014	2016*	Increase
Passenger	1244	1397	153
Elect. Communication	1662	2002	340
Other Electronic	720	856	136
Fallen Object	680	734	54
Fatigued/Asleep	2626	3509	883
Other Inside Vehicle	4419	5343	924
Other Outside Vehicle	4034	4516	482
Totals	15385	18356	2972

* Full year estimate comparison; 2016 was prorated out to a full year.

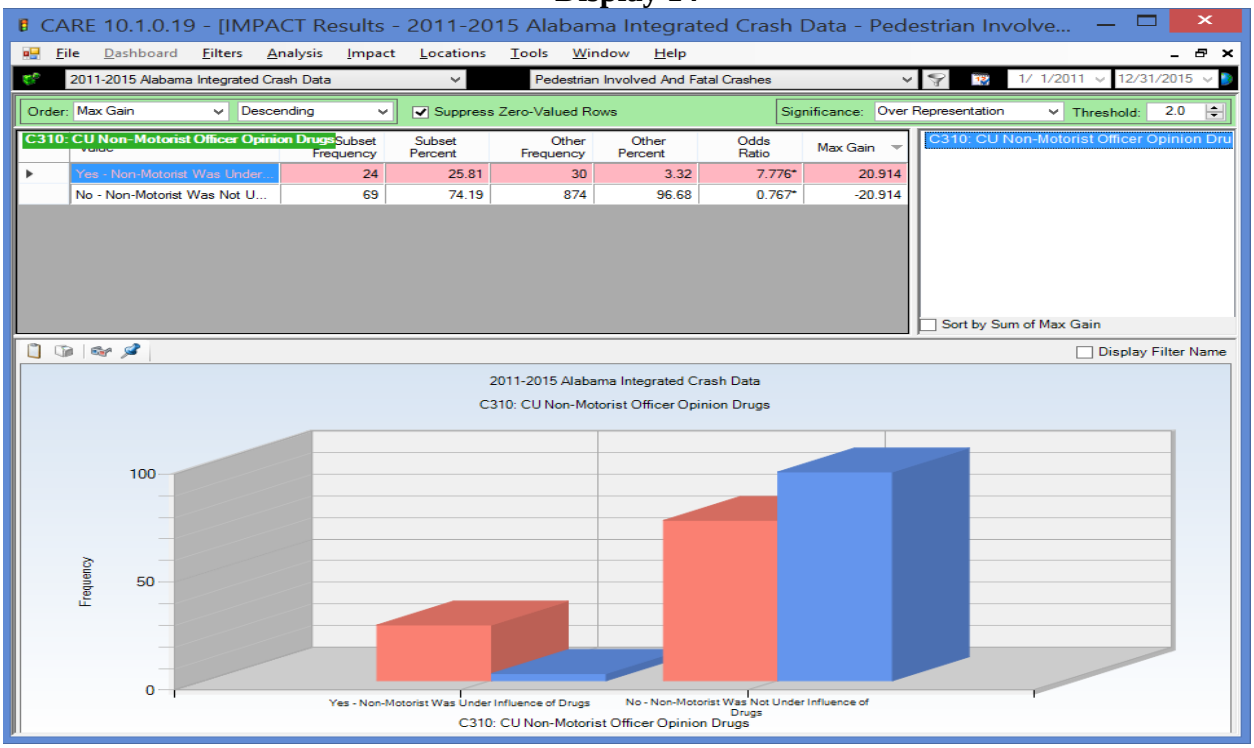
All of the distractive driving categories increased in 2016. A more detailed study of distracted driving is underway. Because this attribute is known to be under-reported, no firm estimates of fatality or fatality increases can be obtained from the Alabama data. However, National studies have generally asserted that distracted driving accounts for from 10% to 16% of all fatalities. The data above from the combined 2014-2016 three-year time period showed that 10.04% of the fatal crashes were either caused or involved some form of distraction. Displays 11 and 12 demonstrate how this increase was distributed among the various distracted driving categories.

7. Pedestrian

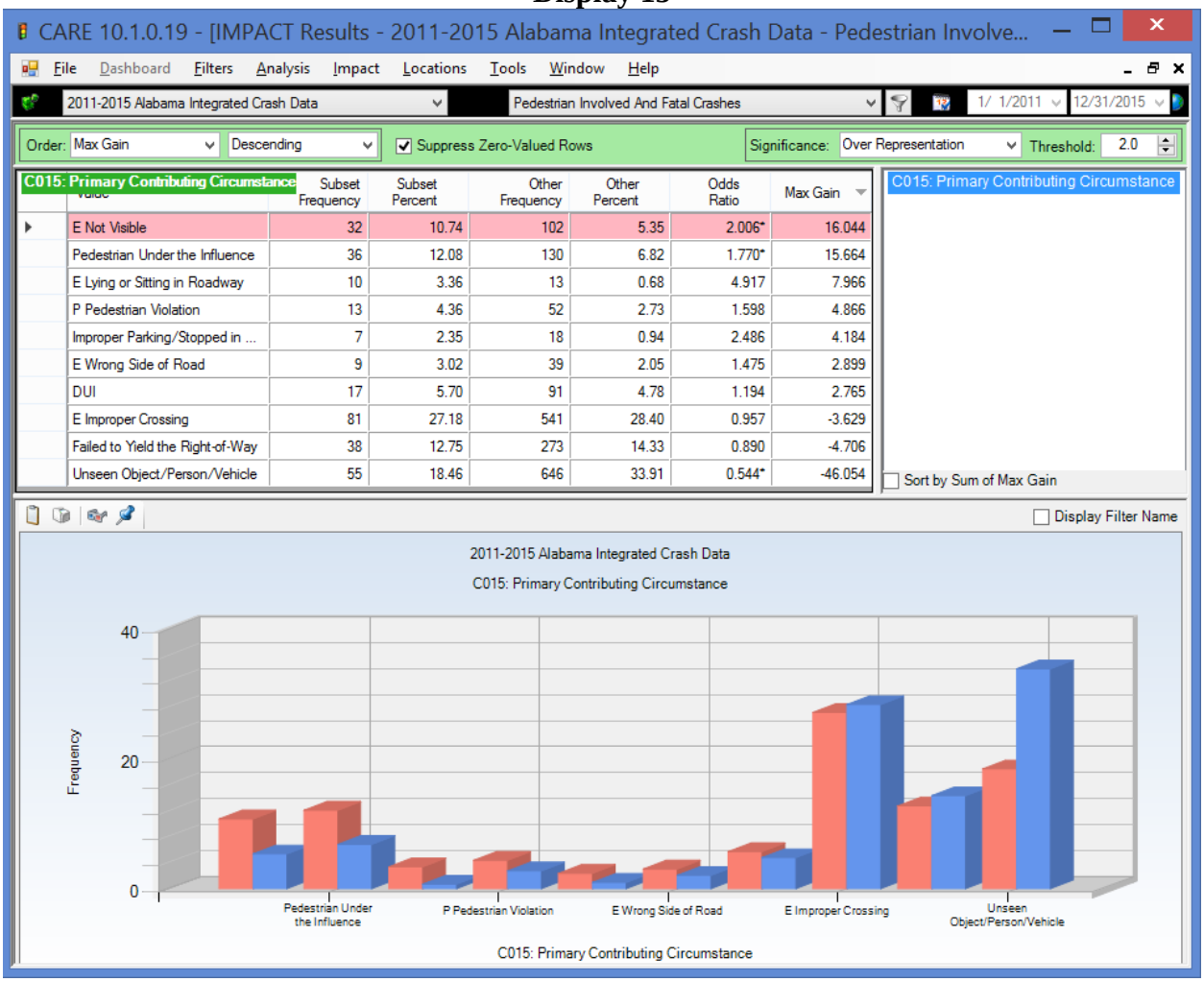
Display 13



Display 14



Display 15



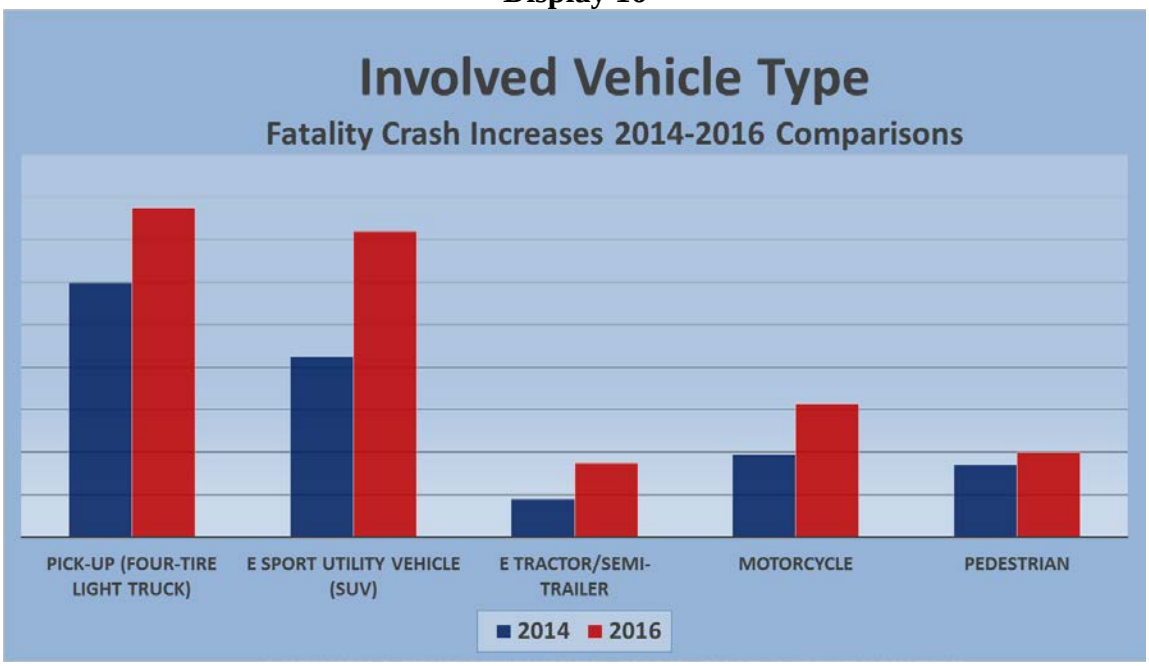
C015: Primary Contributing Circumstance	Subset Frequency	Subset Percent	Other Frequency	Other Percent	Odds Ratio	Max Gain
E Not Visible	32	10.74	102	5.35	2.006*	16.044
Pedestrian Under the Influence	36	12.08	130	6.82	1.770*	15.664
E Lying or Sitting in Roadway	10	3.36	13	0.68	4.917	7.966
P Pedestrian Violation	13	4.36	52	2.73	1.598	4.866
Improper Parking/Stopped in ...	7	2.35	18	0.94	2.486	4.184
E Wrong Side of Road	9	3.02	39	2.05	1.475	2.899
DUI	17	5.70	91	4.78	1.194	2.765
E Improper Crossing	81	27.18	541	28.40	0.957	-3.629
Failed to Yield the Right-of-Way	38	12.75	273	14.33	0.890	-4.706
Unseen Object/Person/Vehicle	55	18.46	646	33.91	0.544*	-46.054

Pedestrian crashes were considered as significant in this study because the vehicle type analysis (Section 8 below) revealed that they caused nearly 95% of the crashes in which they were involved. The Traffic Records Coordinating Committee felt strongly that distractions from the use of electronic devices (e.g., texting) contributed heavily to these crashes, which have increased dramatically from their low of 525 in 2008 to its projected level of 839 in 2016, a 60% increase. There is no attribute on the crash report for distracted pedestrian, so it is not possible to determine the extent to which this is a causative factor. A comparison of pedestrian fatal crashes against pedestrian non-fatals led to the following for developing pedestrian countermeasures:

- Display 13 – fatalities on Interstate, state and federal as opposed to municipal.
- Display 14 – a dramatic factor of 8 times the drug involvement; alcohol was a factor of 2.
- Pedestrian impairment was confirmed by nighttime and contributing circumstances (Display 15).

8. Involved Vehicle Types

Display 16



Display 17

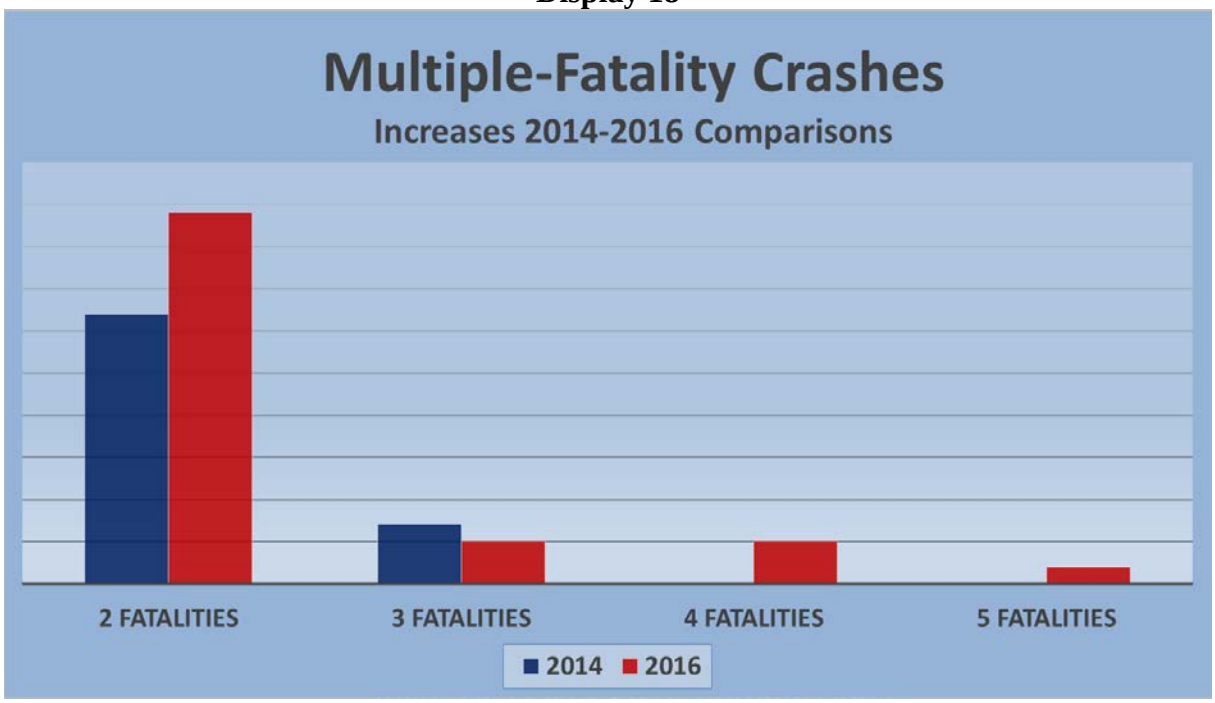
INVOLVED VEH TYPE	2014	2016	% Causal	# Increase	% Increase	% of 133
Pick-Up (Four-Tire Light Truck)	120	155	85.4%	35	29.2%	24.8%
E Sport Utility Vehicle (SUV)	85	144	87.0%	59	69.4%	41.8%
E Tractor/Semi-Trailer	18	35	46.6%	17	94.4%	12.1%
Motorcycle	39	63	80.4%	24	61.5%	17.0%
Pedestrian	34	40	94.8%	6	17.7%	4.3%
TOTAL	296	437		133		

Vehicle types that had the greatest increases are given in Display 17, where pedestrian is considered as a vehicle type. SUVs had the largest numerical increase, although percentagewise they did not have the increase of large trucks. Since the numbers given in the first two columns are *involved* and not causal, it was possible to determine the percent causation of the vehicle types, where causation for all single vehicle and two-vehicle crashes are assigned to the single vehicle type. Some interesting facts that should be considered in countermeasure development include the following:

- While pick-up involvement accounted for the largest number of fatal crashes, their increase was not as high numerically or percentagewise as SUVs.
- The increase in the involvement of SUVs could be due to their increased number on the road, although we would not expect this to increase by nearly 70% in two years, so this vehicle type should be given considerable additional investigation to determine the other factors (perhaps lack of seatbelt use) that contribute to the large increase.
- While the percentage increase in fatal crashes is greatest for large trucks, their causality is well below the expected 50% in fatal crashes involving a heavy truck and a passenger vehicle. This is not completely seen in the 46.6%, which includes single vehicle crashes and crashes involving two heavy trucks.
- Pedestrians had the highest causative proportion, and they are considered separately in Section 7 for this reason and because of their overall increase over the last ten years.

9. Multiple-Fatality Crashes

Display 18



Display 19

			> Total	%	Added
	2014	2016	Fatalities	Increases	Fatalities
1 Fatality	444	560	116	26.1%	0
2 Fatalities	32	44	24	75.0%	24
3 Fatalities	7	5	-6	-85.7%	-6
4 Fatalities	0	5	20	~	20
5 Fatalities	0	2	10	~	10
TOTAL	483	616	164		48

The third column of Display 19 shows the difference in fatalities (as opposed to fatal crashes) when comparing 2014 and 2016. There were an increase of 616-483 = 133 fatal crashes that resulted in an increase 164 fatalities. Ignoring single fatality crashes, there was an increase of 48 fatalities in the multiple-fatality crashes. This accounts for 48/164 = 29.27% or almost 30% of the fatality increase. For this reason we explored some of the aspects of multiple fatal crashes over this time period by comparing them against single-fatality crashes to get information on countermeasure development for multiple-fatality crashes. The following factors were uncovered:

- Ages 16-30 were generally over-represented with a few exceptions; the highest over-representations were in the 16, 19-22, 26 and 29-30 ages.
- State and Federal Roads had the highest over-representations, as opposed to county roads, which were actually under-represented.
- Multiple fatality crashes are caused by some of the most egregious violations, e.g., crossing centerline, wrong way, aggressive driving, etc.
- DUI involvement is a factor, but at about the same as for single fatality crashes.
- Collisions with other vehicles are over-represented, as opposed to collisions with roadside objects (e.g., trees); this is expected in multiple fatality crashes.

Countermeasures which are in place have been successful in modifying behavior of most of the reasonable drivers. This research indicates that special efforts might be required to identify and deal with those who are "beyond the three-sigma limits" as far as reasonableness is concerned. Perhaps some diagnostic tests should be developed during the licensing process, since this is characteristic of the relatively newer drivers. Special programs could be developed for those detected to have potentially negative characteristics. Alternatively, the driver records could be processed to determine those who require such treatment, and the reinstatement of their drivers licenses could be made contingent on their participation.

In closing it is important to note that the general increase in fatalities in 2016 cannot be blamed solely on these or any other small subset of drivers. There is no silver bullet that is going to easily solve this problem, and the comprehensive approach that has been successful in the past needs to be continued. However, each of the individual programs within this general approach need to evaluate and modify their countermeasures based on the findings of this report and the subsequent research that will follow.

10. Recommendations for Additional Detailed Research

The following further analysis is recommended to learn more about the increasing fatalities in 2016:

- A replication of this current analysis once the completed 2016 data are available, comparing these partial to the complete set of annual data.

- Determination of the make, model, vehicle types and model years for those vehicles that are found to have higher impact speeds, as well as a complete analysis of their driver demographics.
- Analysis of the various "over the limit" categories by roadway types and speed limits.
- Determination of driver demographics in a subset of the most over-represented Primary Contributing Circumstances, and a comparison of this between severe injury crashes and other types of crashes to surface potential future fatality causative drivers.
- Analysis of demographics of causal drivers who did not use proper restraints in fatal crashes – recommendation here is to stick with fatal crashes over a longer time frame than just one year since the restraint use attribute in fatal crashes is far more accurate than in crashes in general.
- Analysis of the demographics of drivers *in general* who have distraction-caused crashes, recognizing that any of these crashes could become fatal, or for that matter, if the behavior continues, the next crash could be fatal.
- A comparison between drivers who caused DD crashes against pedestrians to see if they have common underlying characteristics.
- Comparison between drivers of vehicle types that have displayed significant increases in fatality crashes against vehicle types that have not.

Other research ideas are solicited – what do you believe might be productive information that can be obtained from available records?