

ESV 20th Enhanced Safety of Vehicles Conference
**Innovations for Safety:
 Opportunities and Challenges**
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**Real World Application of an After
 Market Driver Human Factors Real-Time
 Auditory Monitoring and Feedback
 Device: An Emergency Service
 Perspective**

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**Some recent USA ambulance
 crash outcomes**

The Front Page
 Ambulance crashes
 Deadly crashes on the road
 Ambulance crashes
 Child in car
 Ambulance driver dies
 Three others transported to hospital

Background: Problems

- ▶ In USA ~8,500 ambulance and fire vehicle crashes/year*
 - One fatality each week#
 - 23 pedestrians or occupants of other car
- ▶ Cost estimates > \$500 million annually
- ▶ Consequences can be predictable & likely preventable
 - Fatal crashes more often at intersections, another vehicle (p < 0.001)*
 - 82% of fatally injured EMS rear occupants were unrestrained**
 - EMS has higher occupational transportation fatality rates than police or fire***
 - 74% of all occupational fatalities for EMTs are MVC related***
 - 70% of fatal crashes EMS crashes during Emergency Use#
 - 10 x as lethal per mile traveled than large trucks##
 - USA ambulance crash fatality rate/capita 35x higher than in Australia

*JURGENS ET AL, 2006-2005
 #Lipka G, Plevinsky BJ, Kahan EM, Prehospital Emergency Care 2001 Jul-Sep;5(3):261-9
 **Blauser, Zelenkova, Levick JJ, Miller, Res, Acad Press 2003
 ***Hagopian, Hartwig, Smith, Levick, Smith, Prehospital Emergency Care 2002
 #Parks, Sauer, Prehospital and Disaster Med, 1994
 ##DUNCAN, 2006

**Persistent disconnect btw
 automotive safety and EMS**

- ▶ Pre-hospital and Emergency Care 2004
 - "EMS vehicle drivers are advised to approach the intersection with great caution, slowing to ensure that traffic has stopped and making eye contact with other drivers before entering the intersection."
- ▶ A strategy of "eye contact" to be made at an intersection with a driver traveling at ~40mph as a safety intervention, is frightening

**Purpose of a real-time
 auditory feedback 'Black box'
 Program**

- ▶ Enhance Safety
- ▶ Improve Driver Performance
- ▶ Save Maintenance Dollars
- ▶ Aid Accident / Incident Investigation

**Driver behavior monitoring and
 feedback device**

Levick NR, Swanson J, Proceedings - 49th Annual Conf. of the Assoc. for the
 Advancement of Automotive Med, September 2005
 AMBEX-999 Research Forum 2006 - Research most likely to change practice award

Preliminary work

- ▶ Implementation of feedback and monitoring system over 2 years
- ▶ Safety performance improvement
- ▶ Cost savings
- ▶ Improved emergency call response times

**Monthly Seat Belt 2003-2004 and Over
 Speed Violation Trends 2003-2004**

I - blind data, no grows
 II - grows & tones ON, with unidentified data capture
 III - identified data

**Total Miles Driven Monthly 2003-2004 and
 Average Between Count Miles 2003-2005**

I - blind data, no grows
 II - grows & tones ON, with unidentified data capture
 III - identified data

How the Device Works

- ▶ Computerized monitoring device installed on each vehicle to measure parameters
- ▶ Each driver has individual key "fob"
- ▶ Data collected every second
 - including: vehicle speed and performance, driver behaviors and emergency mode
- ▶ Auditory feedback of warning 'growls', and penalty tones
- ▶ Data downloaded automatically every day



Objectives

- ▶ To determine if emergency vehicle driver risk behavior can be modified and improved with monitoring device, with real time auditory feedback.

Methods

- ▶ Parameters monitored
 - Vehicle speed, cornering, seat belt use, back up spotters
 - Use of lights and sirens
 - Miles traveled
- ▶ Penalty counts for exceeding parameters are recorded, stored and downloaded daily for analysis and reports generated
- ▶ Response times and fiscal balances were reviewed pre and post implementation

Auditory alarm warning thresholds

Speed	10 second warning period - 73 / 78 mph - >79 mph
Cornering Low Over Force (LFCOUNT) High Over Force (HFCOUNT)	warning at 25% - 38% - 48%
Reverse Count (RVCOUNT)	- 1 count for each time vehicle is placed in reverse without engaging reverse spotting switch
Seat Belt Distance (SBCOUNT)	- 1/10th mile with no belt secured

Implementation Environment

- ▶ CAC deploys 13 units daily, covers 450,000 miles annually
- ▶ CAC has 20 Emergency Vehicles and 11 Non-emergency Vehicles
- ▶ Mean response time of 11 minutes
- ▶ 152 drivers

Study design – graduated implementation

- ▶ Phase I-
 - Blind data - no tones, no ID capture
 - 11/1/04 to 4/30/05
- ▶ Phase II-
 - Warning and penalty tones only
 - 5/1/05 to 6/30/06
- ▶ Phase III-
 - Fully operational, identified data capture
 - 7/1/06 to 8/31/06

Results

- ▶ Over 950,000 miles of vehicle operations were recorded
- ▶ Major reduction in high over speed penalty counts
 - 14.94 penalties/mile in Phase I
 - 0.00003 penalties/mile in Phase III.
- ▶ Major reduction in seatbelt violations
 - 4.72 violations/ mile traveled in Period I
 - 0.001 violations/ mile traveled in Period III a fold reduction in seat belt violations
- ▶ Similar trends were seen in low over speed and over force parameters

Results

	Phase I 11/01/04- 04/30/05	Phase II 05/01/05- 06/30/06	Phase III 07/01/06- 08/31/06
Distance -miles	193,210	682,320	75,957
LSCOUNT [LSCOUNT/mile]	89,250 [0.46]	100,195 [0.15]	98 [0.001]
HSCOUNT [HSCOUNT/mile]	12,936 [14.94]	14,448 [0.02]	2 [0.00003]
LFCOUNT [LFCOUNT/mile]	37,347 [0.19]	64,328 [0.09]	1,250 [0.02]
HFCOUNT [HFCOUNT/mile]	552 [0.003]	1,210 [0.002]	56 [0.001]
RVCOUNT [RVCOUNT/mile]	15,697 [12.91]	69,779 [0.10]	7,100 [0.09]
SBCOUNT [SBCOUNT/mile]	40,893 [14.72]	45,368 [0.07]	90 [0.001]

Direct Cost savings

- ▶ There was a cost saving in vehicle maintenance expenses:
 - \$271,091 in 2004
 - \$242,965 in 2005
 - \$237,193 in 2006

Response times

▶ There was no increase in average response times during the study period:

- 11:14 minutes in 2004
- 10:36 minutes in 2005
- 10:46 minutes in 2006

suggests a moderate overall improvement in response times during the study period.

Crashes

There were:

- ▶ 19 vehicle incidents in 2004
- ▶ 11 in 2005
- ▶ no major vehicle crash during the fully implemented phase of the study period.

A key to safe ambulance transport



Limitations

- ▶ No categorization of type/severity of crash
- ▶ Variable performance and exposure data per individual providers
- ▶ Unique environment may not be uniform across EMS services or generalizable
- ▶ No metric exists to provide a performance measure of the safety or risk exposure of an EMS system – which may differ depending on environment, transport hazards, call incidence and frequency, driver training and age..

Discussion

- ▶ An inexpensive, cost effective, well received and effective after market solution for a very high risk vehicle fleet
- ▶ Need to evaluate long term effectiveness
- ▶ Address whether sensors, tones and alarms are optimized
- ▶ Integrate with other transportation safety technologies, including GIS, GPS and ITS

Conclusion

- ▶ Further demonstration of a dramatic and sustained improvement in driver performance in every measured area with this system.
- ▶ Implementation of this system demonstrated to be a highly effective and sustainable approach to enhancing safety in ambulance transport
- ▶ A highly effective approach to enhancing safety and minimizing risk - requiring minimal inservice training time and optimal safety outcome.
- ▶ Sustainable, cost saving and passive intervention
- ▶ Unique environment for evaluation of system
- ▶ Application potential to broader automotive safety – particularly trucks, teens and fleets.
- ▶ Use of such real time feedback and monitoring should be encouraged for widespread implementation throughout the EMS system to optimize transport safety.

Thank you! Any Questions??
<http://www.objectivesafety.net>

