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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

Nadine Levick MD. MPH
Director, Division of Research, EMS Safety Foundation,
New York, NY, USA

Larry Wiersch & Michael E. Nagel
Cetronia Ambulance Service Executive Director
Allentown, PA, USA

Some recent USA ambulance crash outcomes

Background: Problems

- In USA ~8,500 ambulance and fire vehicle crashes/year+
  - ~ One fatality each week#
    - ~ 2/3 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

+FARS/GES BTS, 2000-2005
** Kahn CA, Pirrallo RG, Kuhn EM, Prehosp Emerg Care 2001 Jul-Sep;5(3):261-9*
***Becker, Zaloshnja, Levick, Li, Miller, Acc Anal Prev 2003*
****Maguire, Hunting, Smith, Levick, Annals Emerg Med Dec 2002*
 # Pirallo, Swor, Prehospital and Disaster Med, 1994
##FMCSA 2006

Persistent disconnect btw automotive safety and EMS

- Pre-hospital and Emergency Care <u>2004</u>
  - *"EMS vehicle drivers are advised to approach the intersection with great caution, slowing to ensure that traffic has stopped and <u>making eye contact with other drivers</u> 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

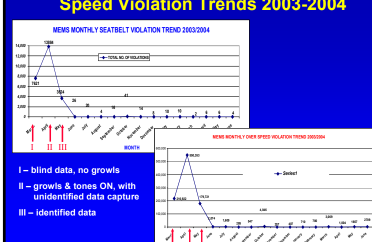
Levick NR, Swanson J, Proceedings - 49th Annual Conf. of the Assoc. for the Advancement of Automotive Med, September 2005

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

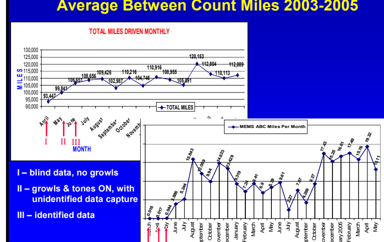


I – blind data, no growls

II – growls & tones ON, with unidentified data capture

III – identified data

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



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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 Low Speed (LSCOUNT) High Speed (HSCOUNT)	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 [2.16]	100,195 [0.15]	96 [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 [12.31]	69,779 [0.10]	7,100 [0.09]
SBCOUNT [SBCOUNT/mile]	40,893 [4.72]	45,366 [0.07]	90 [0.001]

Direct Cost savings

- There was a cost saving in vehicle maintenance expenses:
  - $271,091in 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