Auditory Monitoring and Feedback

Some recent USA ambulance crash outcomes

Background: Problems

- In USA ~8,500 ambulance and fire vehicle crashes/year*
  - ~70% pre-hospital or en-route to other call
- Cost estimates ~ $600 million annually
- Consequences can be predictable & likely preventable
  - Fatal crashes more often at intersection, another vehicle (p = 0.001)
  - 56% of fatally injured EMS rescue operations were preempted
  - 25% higher occupational transportation fatalities than police
  - 3x, 8x, 9x, 10x increased crash fatality numbers for EMS vs. police
  - 9% of fatal crashes EMS crashes during Emergency Use
  - 7x as much per vehicle involved than large truck
  - USA ambulance crash fatality rate is 3x higher than in Australia

*FARS/GES BTS, 2000-2005
**Levick NR, Swanson J, Proceedings - 49th Annual Conf. of the Assoc. for the Advancement of Automotive Med, September 2005
• ~10x as lethal per mile traveled than large trucks
• 70% of fatal crashes EMS crashes during Emergency Use
• >74% of all occupational fatalities for EMTs are MVC related
• EMS has higher occupational transportation fatality rates than police
• 82% of fatally injured EMS rear occupants were unrestrained
• ~ One fatality each week
• Consequences can be predictable & likely preventable
• ~ 2/3 pedestrians or occupants of other car

Pre-hospital and Emergency Care 2004

- EMS vehicle drivers are advised to approach the intersection with great caution, slowing to ensure the 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

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Preliminary work

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


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

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<tr>
<th>Parameter</th>
<th>Phase I</th>
<th>Phase II</th>
<th>Phase III</th>
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<tbody>
<tr>
<td>Low Speed (LSCOUNT)</td>
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<td>Speed</td>
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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
  - 0.00001 penalties/mile in Phase III
- Major reduction in seatbelt violations
  - 4.72 violations/mile traveled in Period I
  - 0.0003 violations/mile traveled in Period III if field is modified in seat belt violations
- Similar trends were seen in low over speed and over force parameters

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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

This 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

- 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

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 in-service training time and optimal safety outcomes
- 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