Accuracy of Reported Crash Times: A Comparison of Rural and Urban Crashes Using Crash Vehicle Telemetry Data

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Outline

• Introduction
  - Literature on Accuracy of Police Accident Report (PAR) Data
  - Why Crash Times are Important

• Comparison of Crash Times Reported in PARs and in OnStar Automatic Crash Notification (ACN) Telemetry Data
  - Methodology
  - Analysis Results

• Summary and Conclusions
A Limited Body of Research Exists on Police Accident Report (PAR) Accuracy

Crash Times from PARS


- Studied notification times in rural and urban Missouri. No truth data, but found evidence of ‘round-off’ errors in Police Accident Report (PAR) reported crash times.

Injury Severity from PARS


- Examined injury codes reported by police (KABCO score) and hospitals (MAIS score) for ~100,000 occupant records in NASS-CDS database. Police KABCO ratings do divide crash population into injury severity categories with reasonable accuracy.


- Studied 11,000 NASS CDS records. Found over-rating of ‘A’; ~50% of ‘A’ injuries were accurate.
Significance of this Study

• Provides a measure of the accuracy of available data on crash time.

• Crash times are important for research on the performance of emergency response systems, evaluating the effectiveness of highway safety improvements, and assessing the timeliness of care provided to crash victims.

  ➢ Longer times from crash to treatment are one of the factors that are used to explain the disproportionately higher MVC-related fatality rates in rural areas.

• Until recently, Police Accident Reports (PARS) and EMS prehospital care reports have been the primary sources of MVC crash time-related data.

• Recent availability of crash telemetry data from vehicles (i.e., OnStar) provides a valuable new source of (truth) data.
Why is Crash Time Important?

Crash time provides the basis for measuring key elapsed times:
- Elapsed time to definitive care = arrival time at hospital – crash time
Average Rural & Urban Elapsed Time from ‘Crash To EMS Notification’ By State

Fatal Crashes (FARS)$^1$

2007

Average Elapsed Time from Crash to Notification (mins)

State

National Average (min)

Rural Crashes

Urban Crashes

% Unknown for Average Rural and Urban Elapsed Time from ‘Crash To EMS Notification’ By State

% Unknown for Rural Crashes (80%) and Urban Crashes (20%) fatal crashes, with a national average of 52% and 45% for rural and urban respectively.
Fatal Rural Crashes in Alabama (644) & Oregon (303);
Elapsed Time from ‘Crash to EMS Notification’

**Alabama:** 51.7% of Rural Crash to EMS Notification
Elapsed Times unknown.
- All due to unknown EMS Notification time

**Oregon:** 12.9% of Rural Crash to EMS Notification
Elapsed Times unknown.
- 32% due to unknown crash time only
- 41% due to unknown EMS notification time
- 27% due to unknown crash and EMS notification times

**Ave (AL) = 9.1 mins**

**Ave (OR) = 6.5 mins**
Study Methodology for Assessing Reported Crash Times

1. Receive OnStar Crash Message Data
2. Compile Research Database
3. Identify Police Agencies & Request PARs
4. Receive PARs
5. Review & ‘Digitize’ Selected Fields
6. Perform Analyses
Source of OnStar Crash Data
Alabama ACN Project

- Collaboration between General Dynamics, University of Alabama, CUBRC & OnStar.

- OnStar ACN digital data delivered in real-time to Birmingham Regional EMS System (BREMSS) Trauma Communication Center.

- ACN data integrated with EMS field data & all shared with receiving hospital.

- Location of ~1500 rural and urban ACN crashes shown on map.

Legend:
- Rural
- Urban
Acquisition of OnStar Vehicle Crash Telemetry for Alabama Crashes

Flow of Digital data

- OnStar Customer Service Center
- Data Routing Infrastructure
- Browser
- Alabama 9-1-1 Centers
- BREMSS Trauma Communications Center (TCC)
- BREMSS LifeTrac System

Voice connection

- Crash data
- Crash Notification & info (by voice)
- Alabama Crash data
- Digital data
- Patient & scene data
- Alert, Patient Data / Triage Support
- Hospital status data
- Patient data & Crash Data
- Patient Pathway

CRASH
Acquisition of Police Accident Reports (PARS) for Alabama OnStar Crashes

- **Alabama OnStar Crashes**: 1495 Crashes, 577 PARs
  - **Non-BREMSS OnStar Crashes**: 1134 Crashes, 468 PARs
    - **AACN Crashes**: 531 Crashes, 300 PARs
    - **ACN Crashes**: 603 Crashes, 168 PARs
  - **BREMSS OnStar Crashes**: 361 Crashes, 109 PARs
    - **AACN Crashes**: 159 Crashes, 68 PARs
    - **ACN Crashes**: 202 Crashes, 41 PARs
Raw Data - Delta Crash Time Frequency Distribution (OnStar ‘Crash Time’ Minus PAR Crash Time)

Average = -5.3 mins
St Dev = 28.5 mins
Raw Data - Delta Crash Time Frequency Distribution
(OnStar ‘Crash Time’ Minus PAR Crash Time)

All 41 crashes occurring in the month following the switch to DST in 2007 and 2008 were in this group.
Corrected Data - Delta Crash Time Frequency Distribution
(OnStar ‘Crash Time’ Minus PAR Crash Time)

577 Crashes

Average = -2.0 mins
St Dev = 24.2 mins

60% of crashes have differences within ±5 min
Consider Most Serious Crashes

- Previously, we discussed importance of accurate crash times for calculating elapsed times (e.g., ‘Crash to EMS Notification’ times)
- Using KABCO score listed on PAR, consider most serious crashes, i.e., those requiring patient transport.
  - ‘A’ = Incapacitating injury
  - ‘K’ = Killed (crash fatality within 30 days).
Rural / Urban ‘K & A’ Crashes
Delta Crash Time Distribution
(227 Crashes)

Rural Crashes
Average = 1.7 mins
St Dev = 14.8 mins

Urban Crashes
Average = 0.0 mins
St Dev = 14.5 mins

Rural & urban distributions are very similar. (KS Test).
Summary of **Absolute Difference Between OnStar and PAR-Reported Crash Times**

<table>
<thead>
<tr>
<th>Bin Delta Time</th>
<th>All Data (Corrected)</th>
<th>All ‘K&amp;A’</th>
<th>All ‘K&amp;A’ Rural (1)</th>
<th>All ‘K&amp;A’ Urban (2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;5 min</td>
<td>346 (60%)</td>
<td>137 (60%)</td>
<td>57 (48%)</td>
<td>80 (74%)</td>
</tr>
<tr>
<td>5 to &lt;10</td>
<td>109 (19%)</td>
<td>49 (22%)</td>
<td>34 (29%)</td>
<td>15 (14%)</td>
</tr>
<tr>
<td>10 to &lt;15</td>
<td>40 (7%)</td>
<td>14 (6%)</td>
<td>10 (8%)</td>
<td>4 (4%)</td>
</tr>
<tr>
<td>15 to &lt;20</td>
<td>20 (3%)</td>
<td>7 (3%)</td>
<td>6 (5%)</td>
<td>1 (1%)</td>
</tr>
<tr>
<td>&gt; 20</td>
<td>62 (11%)</td>
<td>20 (9%)</td>
<td>12 (10%)</td>
<td>8 (7%)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>577 (100%)</strong></td>
<td><strong>227 (100%)</strong></td>
<td><strong>119 (100%)</strong></td>
<td><strong>108 (100%)</strong></td>
</tr>
</tbody>
</table>

1) 36% witnessed  2) 63% witnessed.
Absolute Difference between OnStar and PAR Crash Times for ‘K and A’ Crashes

Percent of Total

K & A Rural
K & A Urban
K & A Total
All Data

Crash Time Bins (OnStar Crash time – PAR Crash time) min
Limitations of Study

• Unable to address issues associated with synchrony of clocks between police (PARS) & GPS (OnStar).
  – This will be less of an issue if more widespread use of computerized crash reporting software (e.g., TraCS, SmartCop) by police at scene.

• When comparing PARS with FARS data, there may be some small differences in definition of rural and urban.

• Data limited to the state of Alabama but expect it can be generalized to rest of country.
Conclusions

• Accurate crash times are important because they are used as the starting point for the calculation of emergency response timelines.
  • Elapsed time computations are used in both operational and trauma system outcome research.

• This study provides the first measure of the accuracy of PAR-reported crash times with respect to truth (OnStar GPS time)

• For ‘K and A’ serious injury crashes in Alabama, results show that the delta crash time distribution for rural and urban crashes are very similar.

• Results show that in Alabama:
  For all 577 crashes compared:
  • 60% of all PARS crash times are within 5 mins of OnStar time (truth).
  • 79% are within 10 mins of OnStar time.

  For the 227 Fatal & Serious Injury Crashes (K and A):
  • 48% of rural PARS crash times are within 5 min of OnStar times.
  • 74% of urban PARS crash times are within 5 min of OnStar times.
Backup
Characteristics of 577 Alabama OnStar Crashes for which PARS Obtained

**Location**
- Urban: 349 (60.4%)
- Rural: 224 (38.8%)
- Unknown: 4 (0.8%)

**Injury Severity**
- Unknown: 1 (0.1%)
- O: 246 (42.6%)
- C: 68 (11.8%)
- A: 214 (37.1%)
- B: 36 (6.2%)
- K: 13 (2.2%)

**Crash Type**
- Unknown: 1 (0.1%)
- Single: 144 (24.9%)
- Multiple: 432 (74.9%)
Characteristics of 577 Alabama OnStar Crashes for which PARS Obtained (Continued)

<table>
<thead>
<tr>
<th>Time of Day</th>
<th>Count</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dawn/Dusk</td>
<td>14</td>
<td>2.4%</td>
</tr>
<tr>
<td>Night</td>
<td>137</td>
<td>23.4%</td>
</tr>
<tr>
<td>Day</td>
<td>421</td>
<td>72.9%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Witness</th>
<th>Count</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unknown</td>
<td>194</td>
<td>33.6%</td>
</tr>
<tr>
<td>No Witness</td>
<td>379</td>
<td>65.7%</td>
</tr>
</tbody>
</table>
Comparison of Witnessed & Un-witnessed, Rural & Urban, Fatal & Serious Injury Crashes

### All Crashes (577)
- **No Witness**: 379 (65.7%)
- **Unknown**: 4 (0.7%)
- **Witness**: 194 (33.6%)

### A & K Rural Crashes (119)
- **No Witness**: 76 (63.9%)
- **Witness**: 43 (36.1%)

### A & K Urban Crashes (108)
- **No Witness**: 40 (37.0%)
- **Witness**: 68 (63.0%)

37% of all crashes
227 ‘K & A’ Crashes
Delta Crash Time Distribution
(OnStar ‘Crash Time’ Minus PAR Crash Time)

- ‘K’ Injury Crashes (13)
  Average = 7.6 mins
  St Dev = 9.9 mins

- ‘A’ Injury Crashes (214)
  Average = 0.5 mins
  St Dev = 14.8 mins

Number of Occurrences

Delta Time (mins) (5 minute bins)