Introduction

Timely response of Emergency Medical Services (EMS) personnel at a crash site may help prevent loss of life and thereby improve the quality of life for an individual at risk. This study was conducted to review The Michigan Department of Community Health, Emergency Medical Services Section data collected over a 5-year period in 2010. Specific intentions were to identify current EMS response, treatment, and transport trends.

The EMS Response Continuum

- Incident locations were partitioned into rural or urban classifications.
- Classification was determined by population density
- Urban: populations greater than or equal to 50,000 residents
- Rural: populations less than 50,000

83 counties in Michigan’s borders. 57 counties classified as rural. 26 counties classified as urban.

The ratio of agencies serving the population for the largest counties (primarily urban) is approximately eight times larger than that of the smallest counties (rural urban). The EMS spent less time on scene when provided protocols indicating specific scene time limits as compared to general instructions (7).

National EMS Response Continuum Statistics

<table>
<thead>
<tr>
<th>Rural</th>
<th>Urban</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dispatch</td>
<td>Avg. time elapsed between crash and EMS notification (percentage involving fatalities) 6 min (43%)</td>
</tr>
<tr>
<td>Response Time</td>
<td>Avg. time elapsed between notification and EMS arrival (percentage involving fatalities) 13 min (51%)</td>
</tr>
<tr>
<td>Percentage of incidents, involving fatalities, responded to in less than 10 minutes</td>
<td>52%</td>
</tr>
<tr>
<td>Scene Time</td>
<td>Avg. time elapsed between EMS arrival and departure from scene involving fatalities (2) 19 min</td>
</tr>
<tr>
<td>Transport Time</td>
<td>Avg. time elapsed from scene to arrival at final destination (percentage involving fatalities) 21-30 min (37%)</td>
</tr>
</tbody>
</table>

Rural & Urban Classification

- For rural areas, acceptable response time thresholds were set at 2 and 15 minutes, and for urban areas, between 2 and 8 minutes. Roughly 80% of all incidents in rural areas and 70% of all incidents in urban areas presented consistent response times at or below the specified thresholds each full year of data collection.

Incident Data

- Number of Reported Incidents per Year
  - Gradual increase in incidents over the five-year period
  - 2014 reporting the highest number of incidents
  - Flexible that the increase in incidents is related to the increased/improved reporting practices
  - 704/932 different agencies reported incidents
  - Peak reporting from 667 agencies in 2014

Unsurprisingly, the number of incidents presented spikes in occurrences during the respective rush hours, with an overall peak in incidents reported (1,652) during the heavily congested evening rush period from 4 pm to 7 pm. Contributing factors may include fatigue of driver and/or high traffic volumes from commuters.

Michigan Motor Vehicle Crash (MVC) Data

Data collected from participating EMS agencies between the years of 2008 and 2015, containing 406,973 unique incident records.

Data Reduction

- Incidents occurring outside Michigan borders were removed
- Records outside of January 2010 and December 2015 were removed
- Data marked as lost and/or training were removed
- Data with inconsistent records such as no agency match were excluded
- Non-MVC incidents were removed, including misclassified MVC records when cross-checked with the EMS personnel information system
- The master data, after reduction and filtration, used for analysis consisted of 283,298 unique incidents, or approximately 68% of the original MVC data provided by the State of Michigan.

Top 20% of Counties Reporting Incidents

<table>
<thead>
<tr>
<th>Top 20% of Counties Reporting Incidents</th>
<th>Pareto Principle: roughly 80% of effects are associated with 20% of the causes.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Michigan</td>
<td>The top 20% of counties with the highest incident frequencies accounted for 76% of the incidents from the dataset.</td>
</tr>
</tbody>
</table>

Response Time Data

Agencies with the longest and shortest response times, on average, were compared and evaluated to investigate the potential differences among rural and urban response time on an agency basis.

Response Time Data

<table>
<thead>
<tr>
<th>No. of Incidents</th>
<th>Range</th>
<th>Data Classification</th>
<th>Average Time (minutes)</th>
<th>Median Time (minutes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rural</td>
<td>409,973</td>
<td>14-154</td>
<td>27-42</td>
<td>50</td>
</tr>
<tr>
<td>Urban</td>
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Scenario Time Data

Average scene time per county was calculated across the five-year period. As noted above, rural areas had fewer incidents and higher average response times; however, we see relatively consistent scene time across both geographic classifications. Therefore, scene time appears to be relatively unaffected by location.

Average Scene Time by County

<table>
<thead>
<tr>
<th>No. of Incidents</th>
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<tbody>
<tr>
<td>Urban</td>
<td>21-30</td>
<td>14-154</td>
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</tr>
</tbody>
</table>

Transportation Time Data

Main insights from transportation time analysis:

1. Urban location of incident yields a lower transportation time when compared with rural regions, potentially due to proximity to hospitals.
2. Rural areas, on average, have longer transport times than urban, 21 to 14 minutes, respectively.
3. There appears to be marginal increase in the average transportation time during the rush hours with a higher increase in time throughout the evening and late night (11 pm – 2am) time slot.
4. Rural locations consistently exhibited higher transportation times throughout the day. A probable cause could be the spreadout and potentially limited number of resources within those locations.

Concluding Remarks

- Michigan EMS Agency data was provided on a voluntary basis (there is no mandate that requires agencies to provide the data to a central agency).
- Procedurally, forms are completed using agency selected software from several existing software vendors, and must be provided within 30 days of the incident.
- A considerable amount of resources were used to salvage records for this study, which is evident in the reported data reduction rates.
- Integrating crash databases maintained by EMS and police departments is highly desirable.
- Two sets of data reside in two distinct databases for the same incident, it is very challenging to link the databases to extract useful information.
- It is very beneficial to have a central body of all contributing agencies.

The current data analysis indicates a total time of approximately 1 hour for completed EMS operation.

Acknowledgment

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References

6. Pons, P.T., J.S. Haukoos, W. Bludworth, T. Cribley, K.A. Pons, and V.J. MySQL. A validation of Michigan EMS Agency data was provided on a voluntary basis (there is no mandate that requires agencies to provide the data to a central agency).