Empirical Bayes Before-After Study on Safety Effect of Narrow Pavement Widening Projects in Texas

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Texas has approximately 40,000 lane miles (64,000 km) of two-lane farm-to-market (FM) and ranch-to-market (RM) roads with total paved widths of 18 to 22 ft (5.5 to 6.7 m), most of which are in rural areas. The goal of this study is to investigate the safety effects of narrow pavement widening projects for rural two-lane FM/RM roads in Texas.

Abstract

Texas has approximately 40,000 lane miles (64,000 km) of two-lane farm-to-market (FM) and ranch-to-market (RM) roads with total paved widths of 18 to 22 ft (5.5 to 6.7 m), most of which are in rural areas. The goal of this study is to investigate the safety effects of narrow pavement widening projects for rural two-lane FM/RM roads in Texas.

Background and Motivation

- Crash rate -- 108.4 per 100 million VMT in 2012
- Crashes happened on these roads -- relative high risk of fatal, run-off-the-road (ROR), head-on (HO) crashes

Methodology

Empirical Bayes before-after method, safety effect of a treatment at a site is estimated by:

$$\delta_{site} = \pi - \lambda$$

where \(\pi\) = the expected number of crashes that would have occurred without the treatment; 
\(\lambda\) = the total number of reported crashes observed in the after period.

Estimation of \(\pi\):

<table>
<thead>
<tr>
<th>Site Type</th>
<th>Project Location</th>
<th>Length (ft)</th>
<th>Number of Crashes</th>
<th>Expected Number of Crashes</th>
</tr>
</thead>
<tbody>
<tr>
<td>FM</td>
<td>Alamogordo</td>
<td>6580</td>
<td>105</td>
<td>78.52</td>
</tr>
<tr>
<td>FM</td>
<td>Midland</td>
<td>1029</td>
<td>66</td>
<td>64.56</td>
</tr>
<tr>
<td>FM</td>
<td>Austin</td>
<td>820</td>
<td>70</td>
<td>59.49</td>
</tr>
</tbody>
</table>

Expected annual number of crashes for the before period (\(N_B\)):

$$N_B = \pi_B - \lambda_B$$

Expected number of crashes in the after period (\(\pi\)):

$$\pi = N_B + \pi_A - \lambda_A$$

Data Description

- 22 Narrow Widening (NW) projects in Texas from 2004 to 2011
- Crash data from 2003 to 2012
- For each project, a minimum of 12 months of crash data was available for the before/after periods
- Reference group: 1,585 roadway segments with similar characteristics as the 22 NW projects

Results

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Before Crash Rate</th>
<th>After Crash Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Crash</td>
<td>108.4 per 100 million VMT in 2012</td>
<td>77.0 per 100 million VMT in 2012</td>
</tr>
</tbody>
</table>

Conclusions

- In general, narrow widening was found to be an effective safety treatment for narrow two-lane FM/RM roads in rural areas.
- Overall crashes decreased by 31.5 percent.
- Significant reductions were found in run-off-the-road and head-on crashes.
- Impacts of narrow widening did not differ significantly among crash severity levels.