Estimation of Safety Effectiveness of Composite Shoulder on Rural Two-Lane Roads

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Why Composite Shoulders?

• Current Situation in Kansas
• Potential System Benefits
• Upgrading
• Environmental benefits
Why the Empirical Bayes Method?

- Most Recommended by the Highway Safety Manual (HSM)
- Adequate data are available in Kansas
What is EB method
Data Collection

- Reference Group
- Treatment Group
- Summary
Safety Performance Functions

- Total
- Fatal and Injury Crash
- Related Crash
## Results

<table>
<thead>
<tr>
<th>Methods</th>
<th>Total Crash CMF (Standard Deviation)</th>
<th>Fatal and Injury Crash CMF (Standard Deviation)</th>
<th>Related Crash CMF (Standard Deviation)</th>
</tr>
</thead>
<tbody>
<tr>
<td>EB with separated SPF’s</td>
<td>1.038 (0.119)</td>
<td>0.938 (0.260)</td>
<td>0.697 (0.241)</td>
</tr>
<tr>
<td>EB with same SPF</td>
<td>1.038 (0.119)</td>
<td>0.880 (0.229)</td>
<td>0.651 (0.205)</td>
</tr>
<tr>
<td>Naïve before-after study</td>
<td>1.211 (0.174)</td>
<td>0.988 (0.355)</td>
<td>0.738 (0.308)</td>
</tr>
<tr>
<td>Combined EB method</td>
<td>1.038 (0.119)</td>
<td>0.909 (0.173)</td>
<td>0.674 (0.158)</td>
</tr>
</tbody>
</table>
Application Examples

Cumulative Crashes Avoided
10 miles of shoulder upgrading per year

Crashes Avoided

Cumulative Related Crashes
Cumulative Fatal and Injury Crashes

Zeng, Schrock
## Application Examples

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Crash Type</th>
<th>Crashes Avoided in 20 Years</th>
<th>Estimated Crash Cost Avoided</th>
<th>Total</th>
<th>Benefit-Cost Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shoulder Widening</td>
<td>Fatal</td>
<td>1.2^A</td>
<td>$5,676,000^B,C</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Incapacitating</td>
<td>2.3</td>
<td>$708,100</td>
<td>$7,003,900</td>
<td>0.064</td>
</tr>
<tr>
<td></td>
<td>Injury</td>
<td>7.3</td>
<td>$573,200</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Nondisabled</td>
<td>4.5</td>
<td>$168,100</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Injury</td>
<td>-50.6</td>
<td>$-121,400</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Possible Injury PDO</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\(^A\text{Data from Zeng, Schrock}\)

\(^B\text{Estimated cost based on typical values.}\)

\(^C\text{Assuming no change in crash rates.}\)
Conclusions

- Adding or upgrading unpaved shoulders to composite shoulders is an effective countermeasure to reduce fatal and injury crashes and shoulder related crashes in rural two lane roads in Kansas.
- It appeared that there exist several possible opposite tendencies for composite shoulders.
- It is necessary to examine the reference group issue when developing SPF in the EB approach.
Thank you!

Questions?

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