Does Urban Sprawl Delay Ambulance Arrival?

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Background

- Urban sprawl is a form of development characterized by low-density construction, disconnected streets, lack of town centers & single-use zoning that separates housing from civic and commercial centers.
- These features of sprawl have been shown to increase trip distances, traffic congestion, and trip time variability for automobile commuters.
- Emergency medical service (EMS) response time and reliability is also likely negatively impacted by sprawl. However, the relationship between EMS response time and sprawl has not been previously measured.

Our questions

Is urban sprawl associated with a) increased EMS response time and b) higher probability of delayed ambulance arrival following motor vehicle crashes?



Methods

- The association between EMS response time & county-level urban sprawl was measured using generalized linear mixed modeling to control for correlation between crashes within the same county while controlling for significant crash-level covariates.
- EMS response data were obtained for 43,424 U.S. motor vehicle crashes from the Fatal Analysis Reporting System (2000-2002). 'Delayed' response was defined as ≥8 minutes, a common performance metric for EMS systems.
- Sprawl was measured using a continuous multi-component county-level index previously developed by Ewing et. al. Sprawl index (SI) values are available for most U.S. metropolitan counties (n=954) and does not apply to rural areas. SI ranges from 55 () to 352 (New York City) with lower values indicating more prominent sprawl. Mean SI=100 (SD=25). Complete EMS & sprawl data were available in 46 states and 797 counties.
- Odds of delayed response modeled as a quadratic function of SI . Predicted probability of a delayed response calculated at 2 index values (±1 SD from mean) to illustrate EMS performance variation between sprawling and smart growth counties.

Results

- Urban sprawl is significantly associated with increased EMS response time and a higher probability of delayed (≥8 minutes) ambulance arrival (p=0.03).
- This probability decreases quadratically (Figure 1) as the county sprawl index increases (signifying less sprawling development) while controlling for nighttime crash occurrence, wet road surface, and presence of construction.
- The predicted probability of a delayed ambulance arrival appears to become more reliable in counties with prominent smart-growth characteristics (i.e. high sprawl index values; see Figure 2). However definitive conclusions are not possible since relatively few counties in the sample met these criteria.

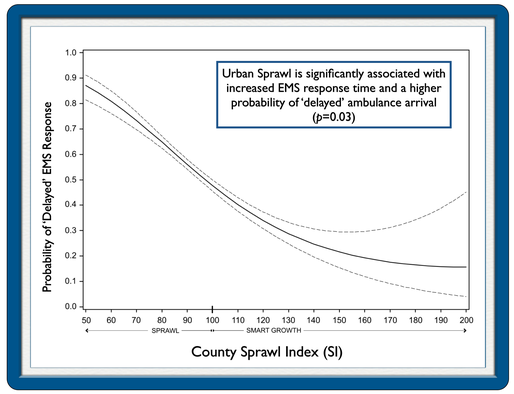

Figure 1. Model-estimated probability of delayed ambulance arrival (≥8 minutes) by county sprawl index.

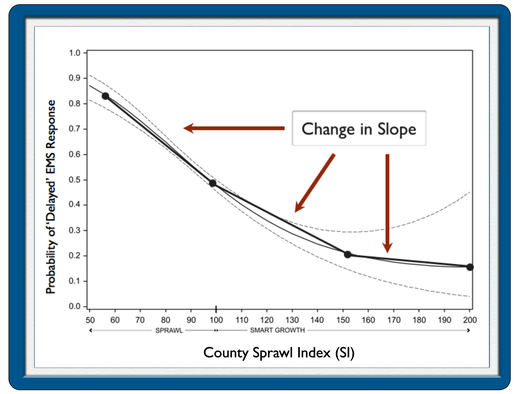

Figure 2. Illustration of change in predicted probability of delayed ambulance arrival over range of sprawl values.

- To further quantify the relationship between sprawl and EMS response time, the predicted probability of a delayed EMS response was calculated for two specific county sprawl index (SI) values while accounting for other significant predictors (Figures 3 & 4). These SI values were chosen to represent counties with significant sprawling (SI=75) and smart-growth (SI=125) development features (mean index ±1 SD).

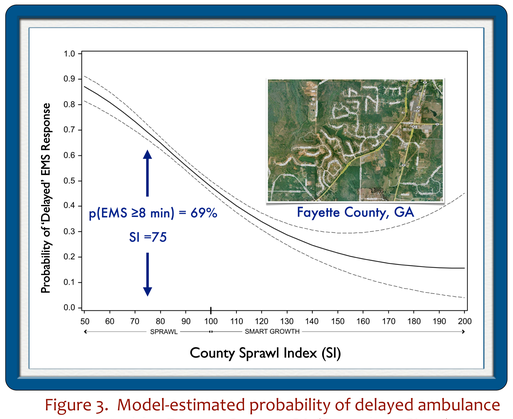

Figure 3. Model-estimated probability of delayed ambulance arrival for Fayette County, GA (Sprawling, SI=75).

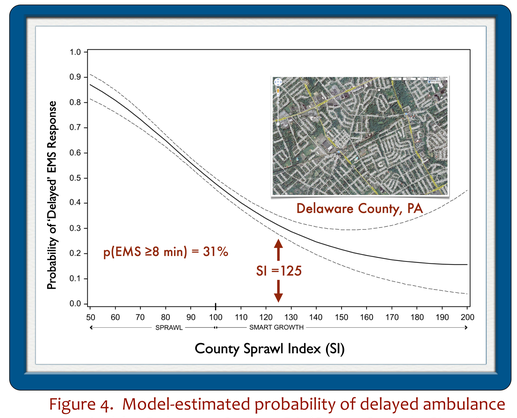

Figure 4. Model-estimated probability of delayed ambulance arrival for Delaware County, PA (Smart Growth, SI=125).

Conclusions

Urban sprawl is significantly associated with increased EMS response time and a higher probability of delayed ambulance arrival following motor vehicle crashes in the United States. The results of this study suggest that promotion of community design and development that follows smart-growth principles and regulates urban sprawl may improve EMS performance and reliability.

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