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# Investigating the Resilience of Accessibility to Emergency and Lifesaving Facilities under Natural Hazards

Project 2126
May 2022

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## Introduction

This study developed an analytical research framework to examine the resilience of the accessibility to emergency and lifesaving facilities under two natural hazards (earthquakes and wildfires) in the San Fernando Valley in California. With this framework, the authors would like to identify the most vulnerable locations in terms of accessibility to emergency and lifesaving facilities (including parks, schools, hospitals, roads, and fire stations) and identify the corresponding needs for more facilities and/or transportation network investments.

## Study Methods

This research framework is constructed with four parts. First, using the cumulative-opportunity approach, the authors calculated accessibility to parks, schools, hospitals, fire stations, and roads respectively within 5 minutes by driving at the census tract level for the case of pre-disaster. Second, by identifying possible natural hazards, the authors recalculated accessibility to these facilities after taking out a part of the transportation network falling in a defined hazard zone in 30 simulations. Third, statistical comparisons are conducted to identify the most affected areas in terms of significant drop in accessibility. Lastly, the authors created a normalized difference accessibility index (NDAI) to indicate whether facility allocation or transportation network should be used to improve the resilience of accessibility in these hotspots.

## Findings

The key findings from this analytical framework are summarized as the following three points. First, there are spatial variations in the accessibility damage hotspots based on the types of "opportunities." For example, under both seismic and wildfire hazards, the accessibility to schools, hospitals, and roads are mostly affected around Van Nuys and Glendale,

while the impact on park and fire station accessibility is relatively more evenly distributed. Second, the statistical comparisons point out the locations with significant accessibility damages to different types of facilities. Under seismic hazards, significant results in accessibility to nearby census tracts are only found in the outskirt areas and fewer locations indicate significant accessibility damage for schools, hospitals, and roads. For the case of wildfire hazards, special attention should be paid to the locations with significant accessibility damage to parks and fire stations, like Van Nuys and Glendale. Third, the calculated NDAIs for the five types of facilities suggest that the outskirt areas and relatively less developed areas in the study region would need more transportation connectivity improvements—such as road network—to improve the accessibility resilience, no matter under seismic or wildfire hazards.

This research framework reveals accessibility damage hotspots and their associated statistical significance levels. NDAIs results suggest outskirt areas and less developed areas in the study region need more transportation investments to improve emergency accessibility resilience.

**Policy/Practice Recommendations**

With this analytical research framework, decision-makers and urban planners are able to identify the most vulnerable locations by considering different types of natural hazards and different types of emergency and lifesaving facilities. Therefore, corresponding facilities and transportation investments can be recommended for improving accessibility resilience efficiently for needed areas.

## About the Author

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Dr. Chih-Hao Wang is an associate professor of the Department of Geography and City & Regional Planning at California State University, Fresno. Dr. Wang's research focuses on environmental planning from the perspective of natural hazard mitigation, land-use and transportation planning, spatial statistics and their allocations, and optimization modeling.

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## To Learn More

For more details about the study, download the full report at **transweb.sjsu.edu/research/2126**

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